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MAY 1964
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Tells How





FLEETSIDE PICKUP (Above) Like all work and play Chevrolets, this one rides like a passenger car with its independent front suspension and coil springs. Available with 6½- or 8-ft. body and standard 140 hp Six. Larger Six or V8 at extra cost.

SUBURBAN CARRYALL (Below) Looks like a station wagon but it's a lot tougher. It's built on a truck frame and holds up to 1,150 lbs. of cargo with the seats removed. Can seat either 6 or 8 people in comfort. Available also in 4-wheel drive models.



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Chevrolet Division of General Motors, Detroit, Michigan.



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comparably low-priced.)

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*Suggested retail price New York P.O.E. includes: turn signal; windscreen washer; spare wheel; tool kit; ash tray light (heater, whitewalls and wheel discs optional).

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POPULAR MECHANICS®

MAY 1964

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INTERNATIONAL EDITIONS • AUSTRALIAN • SPANISH • CARIBBEAN • FRENCH • DUTCH

Features of Special Interest



Midnight
Paratroops
page 76

1964 Indy 500: Who Will Win the First One Pit Stop, 150 MPH Race?	69
Ring-Saving Carb Cuts Knock and Smog	75
Midnight's Sky Divers	76
Owners Rate Their Ford Galaxies	80
Prop Plane with a Jet Inside	85
How Much Excess Fat Do You Carry?	86
Fireman . . . Save My Game	90
Our Navy's Startling New Windmill Submarine	94
Why Not Patent Your Own Invention—I Did!	102
Country-Club Airports	106
Theremin Electronic Music Maker	176

Special Camping Section



Damp
Camping
page 118

Modern Gypsy Caravans	114
Double Cot for Campers	117
Two-Cycle Cookery	117
Snug Camping in Foul Weather	118
Go-Anywhere Trail Mules	122
Buyers Guide to Camp Stoves	124
\$35 Car-Top Motel Pancakes for Travel	128

For the Shop Craftsman



Puddle
Paddler
page 140

Painting Your Fiberglass Boat	134
Sawdust Catcher for Radial Saw	139
Waterbug—a Child's Paddle-Wheeler	140
Ship Carousel Sails on the Lawn	145
Trash Container Hide-a-Way	150
Re-Doing Furniture with Pincore Foam Rubber	152
Moving Target Sharpens the Eye	155
Troubleshooting Carburetors, Part II	158
Fold-up Motor Bike, Part II	165
Strap and Wire Metal Benders	171

Regular Departments

Over the Editor's Desk	6	New on the Market	38
News from the Services	12	Worth Writing For	40
Science Worldwide	14	Solving Home Problems	146
Items from All Outdoors	20	New for Camera Buffs	148
Sidelights on Aviation	22	Shopping for Tools	157
Spotlight on the Ford Mustang	26	Auto Clinic	163
Detroit Listening Post	32	New in Electronics	180
Inventor's Corner	34	Clinic for Homeowners	182

NEXT MONTH: *Wingfoot Express*, jet powerhouse on wheels, is described by its builder, who tells how he'll set a new world's record in it. Also in June PM: an expert teaches water-skiing tricks; lawn mower maintenance lore; an experimenter's Tesla coil; what owners think of their Rambler Americans and Dodge Darts

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MAY 1964

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Over the Editor's Desk

Aerosol Erudition

The article, *Those Handy Aerosols Can Be Dangerous* (page 85, March PM), is very informative; everybody should read it. We are well aware that the general public does not know the many hazards that can develop from the misuse of these cans.

As part of our fire prevention program, we would like to distribute this information to the public, and feel that this education will save someone's life and property.

Prescott Fire Dept. GENE SHIMONOWSKY
Prescott, Ariz. Assistant Chief

Spinning Sails

I have built the model of Anton Flettner's rotor ship, *Buckau*, for a school project



ect (*Model Rotor-Sailing Ship*, page 124, Aug. PM). The model has turned out quite satisfactorily.
Bellaire, Tex.

BILL BARBER

Happy with the Hopped-Ups

This letter comes from the owner of a 20-foot sloop. I read four or five sailing magazines, but your February PM had the best story on sailboat design and speed I

have ever seen in any magazine.

The "How" of *Those Hopped-Up Sailboats* (page 108) was superb. It was clear, full of the latest design news and well illustrated. Frank Rohr, the author, seems to know sailboat design. Please give us more on sailboats.

St. Petersburg, Fla. GILBERT CHAMBERS

BD Is OK

The February issues of both *Popular Mechanics* and *Flying* have articles describing the new Bede BD-1 airplane (*New Plane Breaks Price Barrier*, page 100, Feb. PM).

PM describes the wing spar as a "6½-inch extruded-steel spar." *Flying* describes it as a "6.5 inch cylindrical aluminum spar." Who's right?

Cleveland, Ohio

P. J. HASEY

Aviation Editor Kevin Brown, who flew in the airplane and wrote our story, got the word from the plane's builder, Jim Bede. While original thinking considered the use of steel spars, the actual production models which the public will buy will use extruded aluminum spars.

The article is excellent. Yes, it's almost hard to believe.

I've been flying, testing and owning aircraft since 1938, and this is the best I've seen yet.

Arlington, Tex.

R. P. CRAWFORD

If Kevin Brown's article about the BD-1 is true and the chart on performance and specifications is not fantasy, I want to buy one of the airplanes. It's almost too good to be true.

Bronx, N.Y.

JOHN B. MILLIGAN

Wow! What an article on the new \$2500 BD-1 airplane.

Portland, Ore.

MARION BUSBY

Yes, I agree that this will shake up the aircraft industry.

Montgomery, Minn.

BOB CHROMY

The article has aroused considerable interest in this part of Canada, where at present no private planes are being manufactured.

Sturgeon Falls, Ont.

HARRY A. CONROY

Bede is a fellow to be admired for thinking of the private pilot and all the people who would like to own an airplane without being rich or getting into debt over their heads.

Greensboro, N.C.

CARL G. HODGES

Piano Lesson

Your article *Buy a Piano You'll Keep on Enjoying* (page 124, Feb. PM) is the best story on piano design and speed I

(Please turn to page 8)



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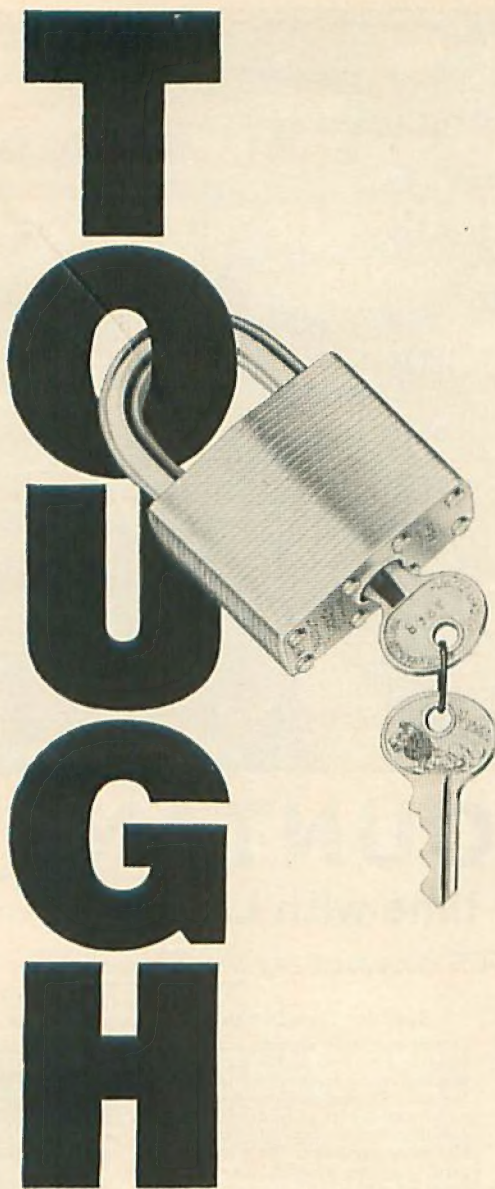
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101



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Over the Editor's Desk

(Continued from page 6)

first I've seen published on this subject, and it should be of help to anyone in the market for a used piano.

As a piano tuner and service man, I find that most homes in this vicinity do not have enough humidity, especially in the winter. Dryness is one of the worst enemies of a piano; it shrinks wood and felt, causing the piano to go out of tune much faster and to acquire rattles in the action.

To offset this, we recommend placing a jar of water in the bottom of the piano. It will evaporate in about two weeks, and then should be refilled.

Arlington, Nebr.

RAY KEELER

Cabin Jet

I built the *PM Jet* (page 150, March 1962 *PM*), using a Berkley jet powered by a four-cylinder Pontiac engine.

This certainly is a wonderful boat that accelerates wonderfully and maneuvers in



very shallow water. And I highly recommend this boat to anyone who would want to build one.

The *PM Jet* has been out on the Pacific Ocean and up the mighty Rogue River—a rough one with more than 30 rapids in 100 miles.

This action photo was taken on Garrison Lake, Oregon. As you can see, I modified the plan and added a small cabin.

Langlois, Ore.

AL BROWN

Guns: Rights and Wrongs

In the debate between Richard Starnes and Senator Thomas Dodd over *Your Right to Own a Gun* (page 94, Feb. *PM*), they both seemed to agree that this right should in no way be curtailed for responsible, law-abiding citizens. I disagree.

The line between the underworld and those of us who have thus far escaped arrest is by no means that clear and constant. People keep crossing over it. One frequent crossing point is where a family argument ends in a shooting—simply because there happened to be a pistol handy.

(Please turn to page 10)

POPULAR MECHANICS

This story actually happened. The man's name has been changed and this is not his photograph, but the facts are true.

"Your name is on the list"



Doug Mott was not surprised. The recession was on and the assembly line where he worked was almost at a standstill.

And then, strangely, the boss began to smile. "You know how the Engineering Department sends us blueprints and then we have to send them back for revision because they just aren't practical to produce?" Doug nodded . . . wondering. "That's waste . . . and we can't allow it to continue. That's why we thought that if we had a man who knew assembly and production — and drafting, too — he could act as liaison man between engineering and production. You know production, Doug . . . and you're studying drafting with I.C.S. You've got a *new* job. Congratulations!"

Doug Mott now heads a drafting room. But he will never forget the day his name was on the list to be laid off.

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Over the Editor's Desk

(Continued from page 8)

Starnes admits that New York's Sullivan Law effectively keeps handguns out of decent, law-abiding hands like his own. Excellent! This may have prevented his shooting some innocent person he mistook for a prowler . . . or some prowler from shooting him . . . or his children from shooting each other.

Austin, Tex.

NEIL HENDRICKS

Your Right to Own a Gun is needed in connection with a congressional request we now have on hand, as well as for other congressional requests on the subject we anticipate receiving due to the interest of Congress.

The Library of Congress BURNIS WALKER
Washington, D.C. Executive Officer

Skittles in the Mountains

The implication that it is necessary to go to England to find a game of skittles (*Any-one for Skittles?*, page 156, March PM) hurts a little.

To the best of our knowledge, this game was introduced to America by Berea College in the 1920s. Sale of the game has become a very important item in the program of Berea College Student Industries, which helps students of the mountain areas of eight states to obtain an education.

Berea, Ky.

G. HAROLD ANDREWS,
Director, Student Industries

She Likes a Rover

My husband called my attention to your *Spotlight on the Land Rover* (page 32, Jan. PM). I was very impressed with some of your comments.

We purchased a Rover 88 about a year ago. Since I had been driving a small foreign car most of the time, I was a little leery. Now I drive it to work every day, back and forth to market and on jeep runs. I wear high heels when I go to work, and this causes no problem. I use the choke like any man, never have bruised my knuckles, and the gearshift is no problem at all. I think any woman can learn to drive a Rover in two days and love every minute of it.

South Gate, Calif.

DOROTHY CEPEK

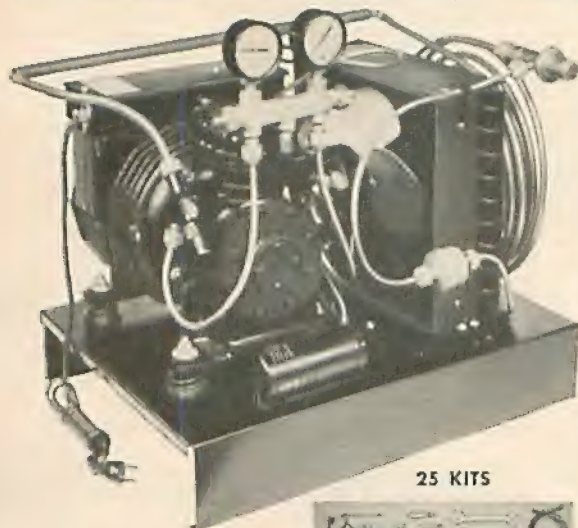
Bachelor Ed Nelson, who wrote the Spotlight report, thinks you must be an excellent driver, Mrs. Cepek—but still doubts that most women would be so happy in the Rover. But then, being a bachelor, he undoubtedly has a lot to learn.

The Editor

POPULAR MECHANICS

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You train at home—Build a complete refrigeration system

In addition to easy, illustrated lessons, CTI sends 25 kits of parts and tools to build a complete, operating refrigeration system. As you assemble your unit, you get practical experience and gain confidence. You become familiar with parts and their functions. You develop skill in using tools. On completing training, you can convert your system into an air conditioner, freezer or refrigerator (from plans we provide). CTI makes home your training center.

Many earn money while learning

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Sidelights from the SERVICES

By William R. Kreh

Quick-release drawers. Going from cold night-guard duty to a hot road march or a heated outpost could become more bearable if an Army officer's idea works out. He's designed some long underwear that zips on the outside of both legs from waist to ankle. When the temperature rises, the wearer drops his trousers, unfastens the sides of the long johns, lifts them out and then raises his trousers, all in about 10 seconds—if there are no women around.

Bandage with a bang. A new explosive, resembling a giant adhesive bandage, has been developed by the Army. The new material comes in sheets only one-fourth of an inch thick. A special adhesive coating on one side enables it to be stuck against practically any surface. The explosive can be cut, hammered, stapled and even burned in an open fire, but it detonates readily when used with blasting caps or detonating cord.

Outer-space ballet. Air Force scientists have devised nine different movements of the arms and legs that a man in outer space, under conditions of weightlessness, could use to change his position. The ballet-type movements have such names as cat reflex, lasso, pinwheel and signal flag. Twist, anyone?

Missile secrets at the Army's Redstone Arsenal are now guarded by sentries who don't carry guns, walk a post or even wear a uniform. They just yell for help with an electronic voice. The sentries are electronic intrusion detectors that are so sensitive they can detect a man walking across a floor or opening a desk drawer. Some are adjusted so finely that they will detect a person doing nothing more than breathing deeply while in the device's sensitivity range.

Flex and fire. The theory of using the human body's electrical impulses to operate complex weapons systems is a step closer to reality. The Office of Naval Research has awarded a contract to study the feasibility of using human electric energy, called bio-signals, to control weapons. Scientists have known about these muscle signals for a long time, but haven't been able to study particular ones which move particular muscles. The signals are nor-

mally only about a ten-thousandth of a volt in strength. The Navy says its study will look at these signals as patterns which move a particular muscle. Thus, electrical sensing devices on the skin could pick up this pattern, step up the signal and send it along a wire to a control device. For example, an astronaut might want to push a button. He thinks of lifting his arm, extending his finger and reaching out. Sensors detect this "thought" movement and do the work for him.

The almighty dollar has caused the Army finally to give up on its much-heralded nuclear reactor at Camp Century, Greenland. The reactor is being taken apart and moved back to the U.S. Army sources say that the experiments that can be conducted with the reactor are no longer worth the costs involved. The Navy is continuing to run its nuclear generator at McMurdo Sound, Antarctica, and there has been no talk of a shutdown despite some problems with the equipment.

Small world. Two Marines, who invented a portable hoist for changing helicopter engines, were flying from Camp Lejeune to New River, N.C., to see how their brainchild was working out in tests at New River. Their helicopter developed engine trouble and was forced down in a tobacco field. A crew from New River was sent to the scene and—you guessed it—used the downed fliers' own device to change the engine in their disabled 'copter.

Big noise. The Air Force is building a special pressure chamber in which humans will be exposed for the first time to the controlled, simulated noise of rocket engines producing multi-million pounds of thrust. Frequency range for the tests will be from 1 to 30 cycles per second and, since the human ear doesn't respond to sounds below about 20 cycles, the test subjects will feel much of the noise rather than hear it. The test chamber is needed because no noise source has existed that has the unique low-frequency, high-intensity characteristics of super-rocket boosters and, as a result, safety levels are so far unknown.

Navy researchers have found that bats often have fatal head-on air collisions despite their heralded "radar" powers. It seems that they have to shut down their sound-ranging system momentarily when they snatch an insect. And while they're chomping, they can run into other similarly-occupied bats. The report was made in the Navy Magazine "Approach" and was entitled, "Beep, Beep, Gulp, Pow!"



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You may be closer kin to gorillas and chimpanzees than you think. Analysis of blood samples and cell proteins show that there's very little difference in makeup between "ours" and "theirs." Of the 146 building blocks contained in the amino acids of human and gorilla hemoglobin, for instance, scientists have found only one point of difference. The similarity is so close that the two could be called blood brothers. Or, as one scientist put it, "it appears that the gorilla is just an abnormal human, or man an abnormal gorilla."

Antarctic seals dive almost 1500 feet deep in the search for food, scientists at McMurdo Sound research station report. The dives are the deepest ever recorded for mammals and result in pressures of almost 700 pounds per square inch, 46 times surface atmospheric pressure.

Grow your own pearls, girls. According to Japanese biologists, all you need are a 10-gallon aquarium with a large supply of sea water, plenty of microscopic ocean dwellers called diatoms and a degree of surgical skill. Japanese pearl farmers now pry open the oyster's shell and carefully insert a tiny piece of mussel shell. The oyster is then placed in the tank, where in time it builds, layer by layer, a smooth pearl around the shell. The diatoms? The oysters feed on them.

Elusive spots on the moon, perhaps caused by escaping gas, will be the target for Air Force photographers come June 4 and 5. That's the date the mysterious red spots are expected to reappear, following two sightings last fall by selenographers—moon mappers—at Lowell Observatory. Six observers saw them near the crater Aristarchus, but the mysterious spots failed to show up on film exposures. This time, sensitive color film will be used.

The dogs know when scientists at the Goddard Space Flight Center are doing at least one kind of experiment. The re-

searchers there have a pump which creates vacuum-like conditions in a room. When working, the pump has a whine so high-pitched it's inaudible to humans but it drives dogs crazy. People in the vicinity know when the pump is working because neighborhood dogs start running around in circles.

Soviet scientists report long survival periods for dogs whose injured nerves were replaced by thin threads of platinum.

Baboon kidneys are keeping a 14-year-old boy at a children's hospital in Miami, Fla., alive. To replace his own useless kidneys, surgeons transplanted four kidneys from two baboons recently in a six-and-a-half hour operation. But it may be months before doctors are sure the boy's tissues have accepted the "foreign" organs and that the danger of infection is past.

Egg squeezing has become a fine art in Great Britain. The object is to tell, without making a mess, how thick the shell is. Put under pressure of three or four pounds, the egg will give a little, enough for a new instrument to measure the amount of give. The more it gives, the softer the shell. Thicker shells, say the experts, mean better quality—and less mess in the egg carton.

The Marfan "syndrome" may have caused Abraham Lincoln's lanky, awkward body build, according to the *Journal of the American Medical Association*. It traced the ancestry of a seven-year-old boy afflicted with this genetic disorder of the body's connective tissue back to the Civil War President's great-great-grandfather. The syndrome is marked by excessive long-bone growth, producing elongated arms, legs, fingers, toes and a long head and facial features.

Electronic computers may someday manage men's lives from the cradle to the grave. General Electric's Dr. Robert R. Johnson foresees the time when mechanical helpers will not only run the furnace and the air conditioner for home owners, but also balance the family budget and tell parents how to rear their children. A computer, he said, could collect "speech and behavioral data on children and analyze it to provide real guidance to their upbringing."

If germs can be made to eat raw petroleum and turn it into protein, then oil wells may eventually supply food for man

(Please turn to page 16)

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Science Worldwide

(Continued from page 15)

as well as for his motors. Considerable progress apparently has been made in this direction by microbiologists at a British oil company. They find that a yeast removes undesirable wax from petroleum to produce a protein. They're now feeding the protein to rats and chickens to see how they thrive. Next would come cattle and sheep, and . . . us?

Insects can be "dried to death" with a new powdered chemical which can be dusted onto the walls and floors of new buildings for indefinite insect-proofing. Developed at the University of California, the dust is called "fluoridated silica aerogel." It removes protective wax from an insect's body, causing its death through evaporation of body fluids.

Dolphin talk may be analyzed and reproduced by marine biologists with a new device. It consists of a bundle of hair-fine quartz fibers of different lengths, which vibrate to sounds of different pitches. Complex mixtures of sounds, like your voice or that of a dolphin, set different combinations of the quartz fibers to quivering.

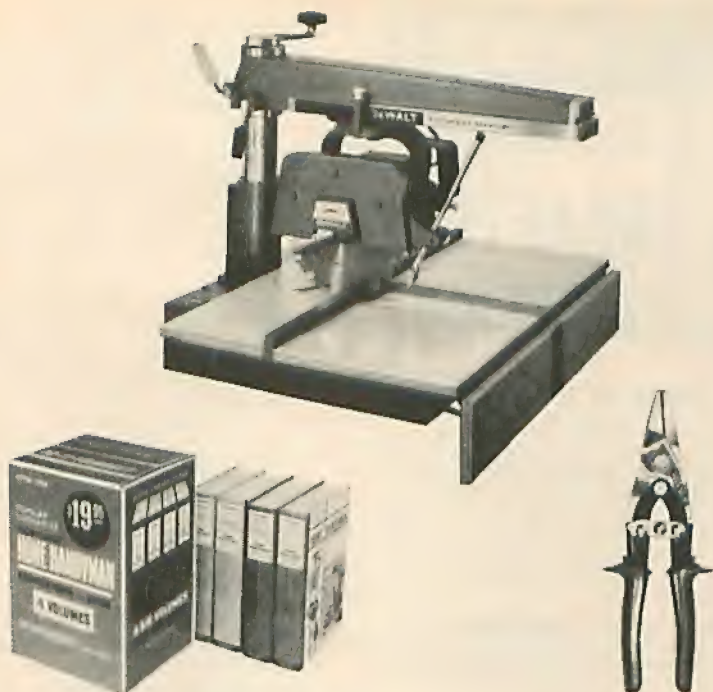
As if that isn't remarkable enough, each fiber is made to pipe a tiny stream of light which wiggles when the fiber vibrates. These wiggles are recorded on film; an analysis of this photographic record of dolphin noises may enable scientists to "break the dolphin code." Now they'll try to imitate the sounds accurately enough to fool a dolphin and to figure from his behavior what the sounds mean.

Cotton boll fragments found in a cave in Mexico refute theories that the cotton plant was introduced into the Americas from either Europe or Asia. The fragments were found in a floor level dating back at least 7000 years and perhaps more. Comparison of the fragments with modern bolls showed no significant differences.

Old English vegetation samples have been recovered recently from the plaster of ancient houses. From bits of straw in the plaster, botanists can tell what kind of barley the English farmer raised in 1425 and what kinds of weeds he was troubled with. From grain left in the straw, they can tell how efficient, or rather inefficient, his threshing methods were.

John P. McNeel
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Precocious Chicks

Two-week-old White Leghorn chicks are smarter than many higher animals who've reached the advanced age of two or more. So says a team of researchers at Pennsylvania State University, who compared the infant biddies with rhesus monkeys and other animals. Even without a well-developed cerebral cortex, the chicks can, they say, form "object-discrimination learning sets."

In layman's language, this means they can learn to peck at the right place in apparatus designed to release food. Most other animal babies, apparently, can only do such uncomplicated things as learning simple locomotion and basic adjustments. The new-hatched chick, the scientists said, is "quite precocious in terms of motor abilities" and probably is smarter than any other animal in the same age group.

Thin Crust

California's underpinnings aren't as thick as those of Colorado and Nevada, the U.S. Geological Survey says. In reporting on the structure of the earth's crust in western United States, the Survey said that seismic probings show the crust to be 30 miles thick in eastern Colorado and only 10 miles thick in California's central valley.

The study resulted from the Vela Uniform program which was set up to explore ways to detect, locate and identify underground nuclear explosions. Some 2000 recordings of seismic waves from underground nuclear and conventional explosions contributed to the study. Thickest part of the crust found so far is that under the Rockies in Colorado, where it may go down 40 miles.

Lunar "Sea" on Earth

"Moon explorations" should be conducted on earth, suggests Dr. Robert S. Dietz of the Navy's Electronics Laboratory in San Diego, Calif. An asteroid crater near Sudbury, Ontario, Canada, is similar to the "seas" on the moon, he explains.

The asteroid fell about 1,700,000,000 years ago with an explosion equaling three million tons of TNT. The shock brought to the surface molten rock (magma) from deep in the earth which flowed into the 30-mile-wide crater, forming a saucer-shaped rock body called a lopolith. Volcanic debris covered the lopolith and a lake formed over the surface.

Dr. Dietz thinks this is the way the lunar seas were formed and that there may be other "moon" features on the earth. The asteroid, incidentally, presented Canada with the largest known store of nickel.

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When spark plugs allow combustion gases to escape, there is a loss of compression with a corresponding loss of power and economy. Leakage of combustion gases, too, can cause overheating and engine-damaging pre-ignition. AC guards against combustion gas leakage with 3-way positive sealing. This helps assure continuing peak power and economy. Next time you change, ask for AC Fire-Ring Spark Plugs.

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Items from All Outdoors

Outdoorsmen who toss over the "stodgy" occupations to work at their favorite sport usually wind up with no time for sport.

We talked with a group of ski instructors in Vermont last March who were planning a late week in Colorado. "It's the only chance we'll have to really ski," they said. And just recently we asked the owner of a large shooting preserve how much time he had for shooting. "Not much time for that," he said. "Much too busy."

But the classic case is Mike Burke of Miami Beach, Fla., who came out of the Navy after World War II with a dream of spending the rest of his days on a sailing ship. He got into the Caribbean charter business, which gradually grew into the famed Windjammer Cruises, Inc., and seven ships ranging from a 96-foot brigantine to a 151-foot schooner. But now Mike does most of his sailing behind a desk. "But I'm going to get out this summer," Mike told us. "I have an interesting cruise in August with the Minneapolis

Inland Divers for a Scuba diving trip through the Bahamas. This club spots sunken wrecks from the air, then they parachute right on the spot and begin diving. That's when we'll rendezvous with them with the ship."

So, even with the "dream job" you have to squeeze out the time for pleasure.

✓ ✓ ✓

Went bass bugging with an old hand the other day and came back with some tips that work. Cast the bug (a small painted cork trailing a bit of feather and a long-shanked hook) with a fly rod and line. Drop it near the roots of a tree or a log, wherever there is some cover. Stop and light your pipe, then give the bug just a slight twitch. If the bass doesn't come after it, let it lie while you count to five, then twitch it again. Count to five again, then give it another twitch. Let it lie for another few seconds, then retrieve it, bringing it in *very* slowly.

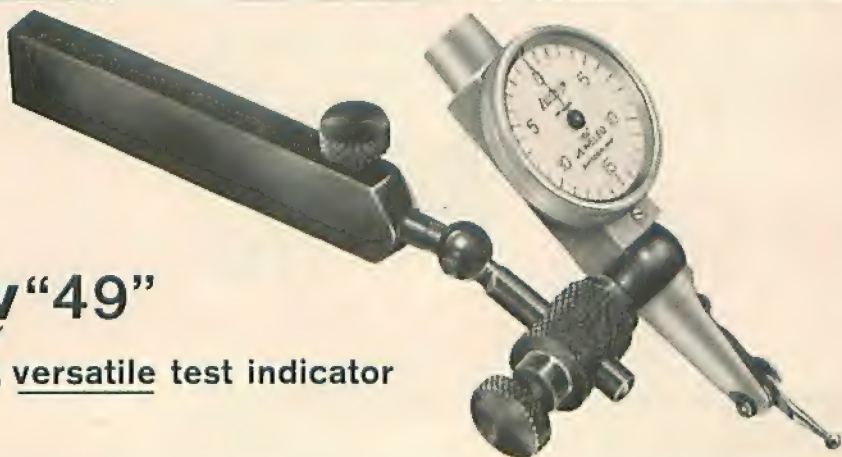
Try this same procedure at least twice in each likely spot; if you don't score, it is because there were no fish there, or they didn't like your bug if there were—two good reasons to try another place.

STUART JAMES

Outdoors Editor

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Sidelines on

AVIATION

"Reconnaissance missions" over Communist countries, reportedly being made by the recently unveiled A-11, revive a question that has never been answered. Just how low can an aircraft or a spacecraft fly before it invades the "sovereign territory" of another nation?

The U-2s flew at about 70,000 feet, and at least one was shot down. The A-11, a Mach-3.5 speedster, reportedly cruises at 100,000 feet. The X-15 has flown to 67 miles (354,200 feet) while some of the manned spacecraft have made orbits below 100 miles without being molested. Just where does sovereign airspace end and international outer space begin?

No demarcation line has ever been agreed on. One Air Force scientist says it should be at least 60 miles above sea level (100 kilometers), where aerodynamic forces become negligible and ballistic forces take over. But no international organization, nor any individual country, has ever recognized this or any figure.

According to William A. Hyman, a New York lawyer and president of the Inter-American Bar Association's committee on interplanetary space, the problem has been ignored or bypassed by the United Nations, the American Bar Association, the National Aeronautics and Space Administration and the U.S. State Department.

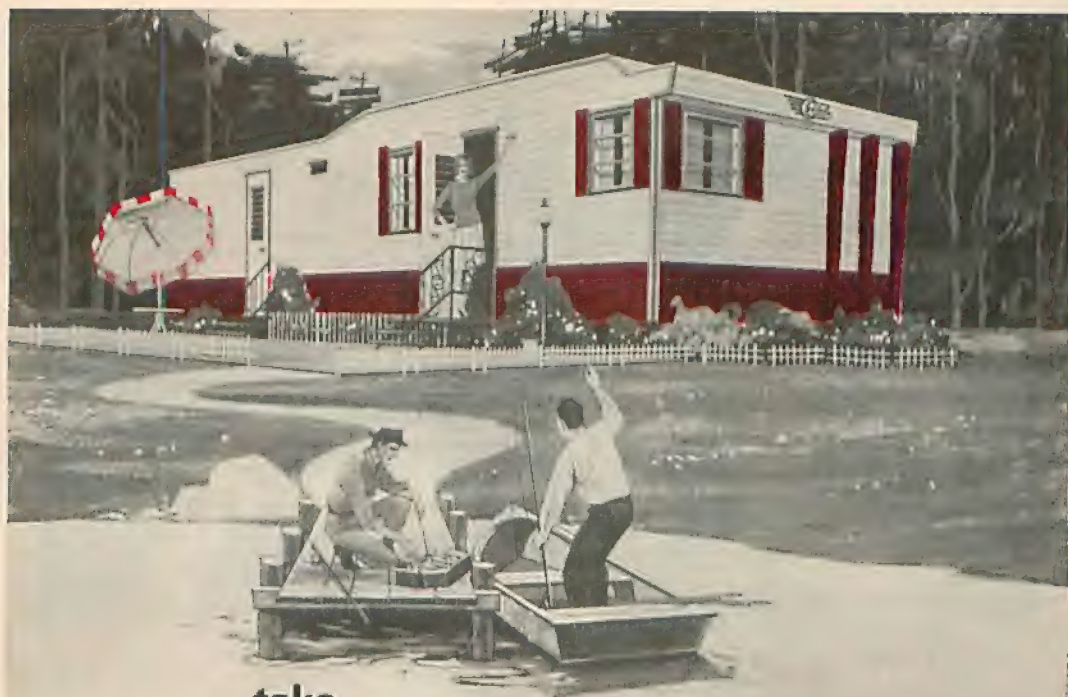
"The problem is compounded," he says, "because we've never even been able to agree on how far into international waters a nation's sovereignty extends and we've been sailing the seas since time began."

The United States claims jurisdiction within three miles of its coastlines and Russia claims 12 miles. When Russia shot down an American bomber it said was flying within the 12-mile limit and when the U.S. arrested Cuban fishermen it said were within three miles of its coast, both caused international incidents.

Hyman would like to see not only a demarcation between airspace which belongs to individual nations and outer space which belongs to all nations, but a buffer zone in between which would be neutral and belong to no one. It would give spacecraft an extra zone of safety during take-offs and landings in case of some small miscalculation.

Kevin W. Brown
Aviation Editor

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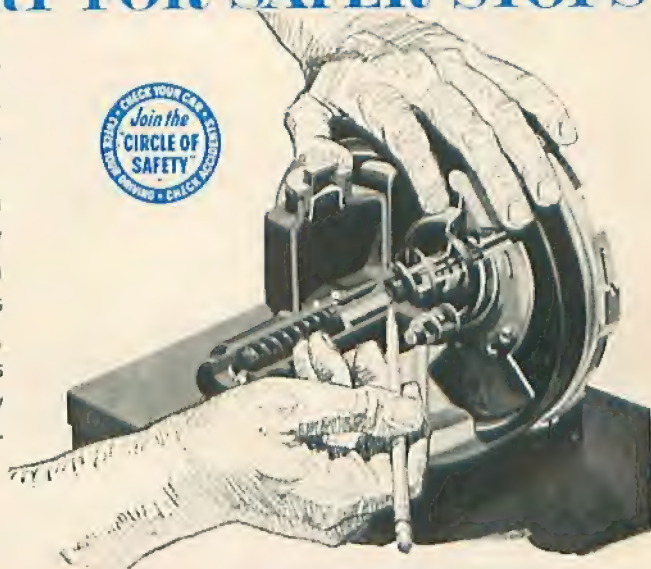


Newlyweds in Japan have it made. For about \$45 a month, they can buy a completely equipped miniature house—with car and carport—from a Tokyo department store. The complete price of \$2830 includes a small lounge, bedroom with

double bed, a kitchen with cooking range and refrigerator, washing machine, bathroom, 14-inch TV set and chairs and tables. The car is a Japanese-made Mazda which normally sells for about \$933. Down payment on entire package is about \$850.

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SPOTLIGHT ON THE



FORD MUSTANG

You can have this new four-place sports car as a cool Six for the road at \$2368, or as a red hot 271-b.hp. V8 ready for competition

By Jim Whipple

FORD has done it again, but this time at popular prices!

Back in 1955, Ford Motor Company took the engine, transmission and driveline from the Fairlane V8, placed them under a low, rakish two-seater and called it a "personal" car.

Selling at \$3000, and accommodating only two passengers, the Thunderbird was not everyone's cup of tea. Sales never rose above 20,000 units a year.

Now, ten years later, comes the Mustang, a four-passenger, semi-sports car with a rock-bottom base price of \$2368 (at Detroit with six-cylinder engine, and a three-speed stick shift).

How She Handles

In touring trim, the Mustang handles as well as or better than any four passenger U.S. production car. You can wind it into a tight corner with touring pressures (24 pounds) in the tires until the soft springing has the car practically walking on its outside wheel rims, and it will maintain a moderate, safe degree of understeer and remain under perfect control.

Pouring on additional power after entering the turn brings you around in great

shape although with heavy tire scrub.

Mustang cruises comfortably and reasonably quietly at 80-85 and we experienced no ill-ease from "float" or wind wandering of the front end. The ride is quite comfortable if not really limousine-like on all surfaces.

All around handling behavior of the Mustang set up for touring was so good that it made us itch to try the special handling package available for it. This deal consists of stiffer front coil and rear leaf springs, larger anti-roll bar, larger and firmer acting shocks and, best of all, a quicker over-all steering ratio of 22 to 1 (3½ turns lock to lock). This, incidentally, is comparable to Corvette's optional quick ratio. For those who view steering as a chore to be minimized rather than a skill to be mastered, there's power steering with the quick ratio.

Tires with the handling package are 14 x 6.50 in contrast with the touring tires of 7.00 x 13. Later sports tires of 5.50/5.90 designed for competition will be available on 15 x 5½ rims.

Mustang is basically Falcon and Fairlane chassis hardware combined with one of the most cleverly engineered unit construction bodies seen in a long time.

The idea of designing a sports car utilizing available engine and chassis parts from a standard line of passenger cars is not new. It's the same formula that got MG started in England almost forty years ago. But it's the only way you can build a sports-type car at anywhere near reasonable prices.

Although it's not an all-out sports car



CONVERTIBLE version of the Mustang is built on the same platform type chassis as the coupe. Vinyl top is spring counterbalanced and can be easily operated by hand. Power operation is optional. Standard wheel size is 13x6:50

in the same terms as is the Ford-powered Cobra produced by Carroll Shelby, the Mustang comes as close to this category as you can get and still sandwich in a rear seat adequate for two extra passengers, and an 8.8-cubic-foot trunk.

Mustang's curb weight of just 3078 pounds with 289 c.i.d. V8 engine gives it a very respectable ratio of 11.3 pounds per horsepower when equipped with the high-performance 271-horsepower version of that engine.

This puts Mustang somewhat below the "all-out" Corvette which weighs in at 3100 and is available with the 375-horsepower fuel-injected engine.

For the purposes of competition—(the money-no-object kind)—the 289-c.i.d. V8 can be pushed to over 350 horsepower, which is how Shelby sets it up in his competition Cobras.

According to Ford General Manager Lee Iacocca, the Mustang will be raced in Sports Car Club of America's modified production GT class. Shelby will enter three cars "prodded" to the extent of front disk brakes and independent rear suspension of the same type used on the original rear-engined experimental Mustang (PM Nov. '62, page 93).

Mustangs will be entered in the Shell 4000 rally in Canada as well as the full rally season in Europe this summer.

The car will be road raced, in modified form on circuits from Spa in Belgium to Monza in Italy.

When asked how he thought Ford's new baby would do in this ambitious competition Iacocca replied, "We plan to finish

ahead of the Sting Rays (Corvettes) and just behind the Cobras!"

PM sampled the Mustang in both hard-top and convertible versions, one with 260-cubic-inch V8 of 164 horsepower and 258 pounds feet of torque at 4400 and 2200 r.p.m. respectively, the other with the 289 V8 of 210 horsepower (4400 r.p.m.) and 300 pounds feet of torque (2400) r.p.m.

Both of these engines operate on regular grade gasoline, but the larger 289 with its four-barrel carburetor will tend to use more of it.

For most people, who will use the Mustang as a fast, nimble "Gran Turismo," touring car, the 164-horsepower engine will do the job nicely. The 289 V8 is for those who wish to dig out a bit quicker

(Please turn to page 28)

OVER-ALL LENGTH of 181 inches plus long hood doesn't leave room for more than this 8.8-cubic-foot trunk which just swallows Mustang's 7.00 x 13 spare



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NEW YORK WORLD'S FAIR '64-'65

Spotlight on the Ford Mustang

(Continued from page 27)

from the traffic lights and climb long grades at 80 m.p.h. The 289 V8, with automatic transmission, will get from 0 to 60 in about 7.8 seconds with just the driver on board.

For those who are crazy about Mustang's size and shape but don't care about kicking up heels, there's the standard six-cylinder Falcon engine of 170-cubic inches and 101 horsepower. This engine, coupled with Cruise-O-Matic automatic transmission, will delight the ladies who want to be chic but not too quick.

All four engines, Six, 260 V8, 289 V8 and Performance 289 V8, can be teamed up with either three-speed manual all synchronized transmission, or the three-speed automatic.

Four-speed synchromesh is available on the Six or with either of the 289 V8s. Ratios on the V8 version of the four-speed are 2.78 to 1, 1.93 to 1, 1.36 to 1 and 1.00 to 1 for 1st through 4th. These are the sporty gears that will delight four-on-the-floor fans who like to stir well while using.

All in all, the Mustang represents a fine addition to the automotive scene. In six-cylinder form it will match price tags with Corvair while outhandling it, and when V8 power is added, it will leave Corvairs gasping for breath.

For a bit more money—though less than Corvette—with the high performance 271-horsepower V8 and the handling package, it will loom large in a lot of Sting Ray rear view mirrors in racing and rallies all over the U.S.

It's a great little car, equally at home (when in appropriate trim) on milk runs with the family, or in gung-ho competition. A lot of people have waited a long time for a car like this and we think most of them will welcome Mustang with open arms. ★ ★ ★

Debris Spreads Forest Fires

Nature is an untidy housekeeper, and this is the major cause of forest fires.

A two-year study by the Washington State University Division of Industrial Research shows that it is the blanket of small twigs and pine needles that spreads the 13,000 blazes that destroy nearly half a million acres of American forests yearly.

Investigators, led by Dr. E. Roy Tinney, found that almost all forest fires start on the ground. "Even when lightning hits the top of a tree," Dr. Tinney says, "the fire usually travels down the tree and then spreads along the ground."

A MESSAGE TO CAR BUFFS -

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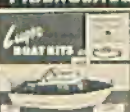
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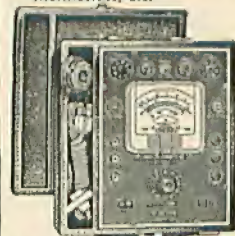
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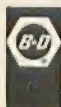
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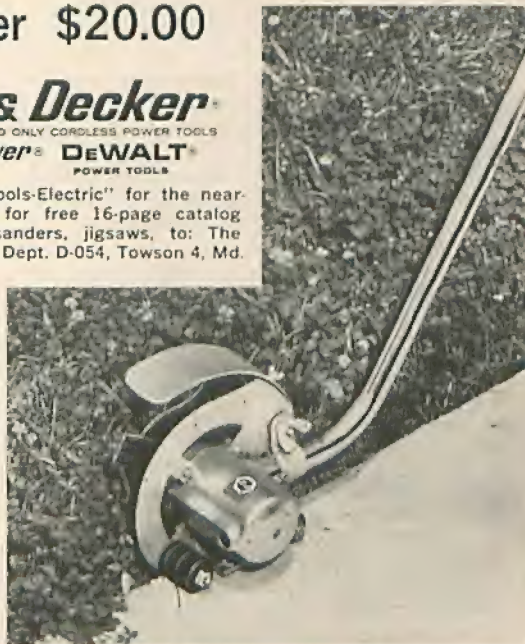
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DETROIT LISTENING POST



By Jim Whipple



Rambler Enters a New Six in Mid-Year Parade; Corvair Due for All-New Sheet Metal in '65

Rambler joins the 1964-and-a-half crowd by introducing a brand new six-cylinder engine on Classic models at \$49.95 extra over the standard overhead-valve Six. The new engine is standard equipment in the new Classic two-door hardtop model called the Typhoon.

The new engine has a displacement of 232 cubic inches compared to the "old" Six's 194. Not surprisingly, the horsepower jumps from 127 to 145 while torque is rated at 215 pounds-feet at a lazy 1600 r.p.m.

The new Six weighs just 415 pounds, 11 percent less than the previous job. Both head and block of the new plant are cast iron, so out goes the optional diecast aluminum version of the current (now "standard") Six.

The new engine is a short stroker—3.75 bore, 3.5 stroke—with a seven-main-bearing, fully counterweighted crankshaft.

An engine like this, which costs (according to American Motors) \$33 million to place in production, is thoroughly modern, efficient, long wearing and reliable, but it has all the mechanical glamour of a well built sewing machine.

That's just what American Motors wants of course—sewing machine smoothness and dependability, resulting in fuel economy and low upkeep.

American executives probably feel that there's enough razzle-dazzle in their new styling without putting any under the hood. The new engine also means that Rambler intends to stick to its tradition of no-nonsense transportation; it is unlikely that this thrifty firm, having put a bundle in the new Six, will spend millions on a lighter, much more powerful V8. So don't look for any Ramblers in the lineup at any stock car tracks in the near future.

It would be nice to see an exotic new engine unfolded—something of Vee configuration in die-cast aluminum with overhead camshafts, but it just doesn't make good economic sense when there's room in the car for an in-line Six, and when all the power necessary can be developed at engine speeds that do not tax push-rod valves and hydraulic lifters.

In spite of the apparent doldrums on the design and engineering scene, there's con-

siderable activity behind the chrome curtain.

Suspension systems have reached a "design plateau" from which they must move in order to provide a greater degree of comfort on our many miles of less-than-perfect roads and streets. No suspension breakthroughs have come from Detroit since the debut of Chrysler's torsion bar design in '57 and the introduction by Ford, of recessive, "roll-with-the-punch" linkage and shackles a few years ago.

General Motors is already hip deep in the business of changing over to more efficient and smoother-acting automatics such as the new ones on Buick and Olds.

But switching the pitch on the manufacture of about 3 million transmissions a year shapes up as a fair job of retooling even for a giant like GM.

Meanwhile, back in the market place, the pressure of competition is keeping the sheet metal sculptors busy, tooling up for restyle for 1965.

After a comfortable run of five years without changing a crease in basic sheet metal, Corvair is in for a stem-to-stern reworking for '65. A switch to fastback styling for the Monza coupes would be almost a foregone conclusion after Falcon's success with the Sprint.

It's quite possible Corvair will drop the four-door sedan for '65 and stick with just a coupe and convertible.

This would put their car right in line with Ford's Mustang for a more compact and realistic model lineup.

Corvair will be hurting for more power to match the easy engine power boosts—170, 260, or 289 cubic inches—available to Mustang buyers at the store. Chevrolet Division may try to get by for a year on the impact of restyling.

Things are looking up for the aluminum engine boys. A new composite cylinder lining is said to have reduced aluminum cylinder wear without affecting its machineability. This lining consists of metals, oxides and carbides so combined that a relatively soft metal matrix—in this case sulfamate nickel—holds together a system of fine, hard particles that resist scuffing wear. Cost is said to be compatible.



I wouldn't stand in the middle of the page if I were you...
It's a Pontiac GTO!

If you insist on reading at a time like this—that's a 6.5 litre Gran Turismo Omologato aimed right at you, 325 bhp @ 4800 rpm with 1-4BBL. It may have an optional 3-2BBL setup with 348 bhp, look lively! As it goes by, notice the nylon red-circle tires and dual exhausts. Listen to the standard 3-speed transmis-

sion with Hurst shifter going through the motions. Or, the fully synchronized 4-speed on the floor*. Or, the automatic* transmission with column shift—you can't tell from here. It may even have a console*. Like every GTO, it has heavy-duty springs, shocks and stabilizer. Quick, get off the page! *Optional at extra cost.

the GTO makers—Pontiac

PONTIAC MOTOR DIVISION • GENERAL MOTORS CORPORATION

INVENTORS' CORNER

By Joseph H. Kraus

Mr. Kraus has been helping inventors solve their problems since 1919. Readers may send queries on ideas, inventions and patents to him, care of *Popular Mechanics*. Questions of general interest will be answered in this column. Please include all information necessary to understand the proposed idea or invention, plus your return address.

Theater seat indicator—diagrams and description of device to show which seats are available were submitted by John Killip of Croydon, Pa. What is the potential?

Large movie houses in New York had such indicators at least 30 years ago. Currently, theater owners are not much interested in adding expensive new equipment. Television has put too big a crimp in movie attendance.

Ignition system eliminates the rotor and distributor on an eight-cylinder car motor, submitted by Francis Schwab of Lakeville, Ind. Idea has been searched. Is anyone interested?

I doubt it. Did you estimate how much more it costs to produce and install eight units instead of one? How thorough was your search? You should look into the ignition systems used on the old Ford Model T. You seem to have reinvented an early type of ignition long since replaced.

Collapsible camper to be carried on top of a car—plans submitted by M. D. Shirley of Kansas City, Kan. He understands that it is impracticable to patent it; was advised to protect a trademark. Could someone sue him if he used the name without legal protection?

First, I don't think you can anticipate a satisfactory return through the sale of construction plans for just one item. But, who said a patent is impracticable? Your photo seems to indicate otherwise. See a patent attorney about obtaining a design patent. The name "collapsible camper" is not listed in my directories but these may not be complete. If the name was not registered previously there's nothing to prevent your using it—and so could others, unless you register it.

Automatic fishing device is said to lock a rod and reel in a box, signal a strike,

land the fish and will shock any person who tries to steal it; patent applied for by James E. White of Dallas, Texas, who has built several at a cost of \$3.75 each. Is there a market for such a device? What should be the selling price?

Assuming that it works as described, I think it might sell in limited quantities. It might be especially good for night fishing and fishing through the ice. But at the production cost quoted, you'd have to charge at least \$18.75 for it, high for most fishermen. I also question the value of the shock as a deterrent against theft.

Heating and ventilating system; diagrams and patent specifications submitted by David R. Hill of Stirling, Scotland. What is my opinion on its merits?

It will cost more than twice as much to heat a house by the method you describe and for which you are seeking patents in several countries. A simple model, clock and thermometer would disclose this to you quickly. Most of your heat will be dissipated into the outside air. Test your theory before you find yourself the owner of a stack of costly but worthless patents.

Crayon eradicator which will remove crayon marks, even from printed material. Does it have any merit?

It certainly is worth investigating, for both patent and market potential. If it does a competent job it should sell.

Patent Resources, Inc., a New York firm organized to exploit patented ideas and help inventors find manufacturers. John R. Maxim of Cincinnati, Ohio, wrote several times for the company's submission forms but received no reply. What should he do?

This organization offered to investigate ideas, pay for the patenting of those it considered worthy in exchange for an interest in the patent. After I called attention to its program, it was so swamped with inventions that it may take years merely to get out from under the avalanche. Forget all about it and carry on as before.

Egg opener, a mechanical device developed by Roy F. Bain of Baltimore, Md. What do I think of it?

This depends on its construction and performance, only a part of which was described. If the tool is troublesome to wash, storage is a problem, if thin-shelled eggs might be smashed, or if a bad egg might drop into a batch of good eggs previously opened, you had better not take a chance. But if you are satisfied, your next step should be a patent search.

(Please turn to page 36)

1963 USAC AND NASCAR WINNERS

*DAYTONA BEACH 500 (Feb. 24)	Tiny Lund
*ATLANTA 500 (Mar. 17)	Fred Lorenzen
*BRISTOL 250 (Mar. 31)	Fireball Roberts
*TRENTON 100 (Apr. 21)	A. J. Foyt
*INDIANAPOLIS 300 (Apr. 28)	A. J. Foyt
*DARLINGTON 300 (May 11)	Joe Weatherly
*INDIANAPOLIS 500 (May 30)	Parnelli Jones
*CHARLOTTE 600 (June 2)	Fred Lorenzen
*MILWAUKEE 100 (June 9)	Rodger Ward
*LANGHORNE 100 (June 23)	A. J. Foyt
*ATLANTA 400 (June 30)	Junior Johnson
*PIKES PEAK 12.4 (July 4)	Bobby Unser
*DAYTONA BEACH 400 (July 4)	Fireball Roberts
*MILWAUKEE 200 (July 14)	Don White
*BRISTOL 250 (July 28)	Fred Lorenzen
*TRENTON 150 (July 28)	A. J. Foyt
*MILWAUKEE 200 (Aug. 15)	Parnelli Jones
*SPRINGFIELD 100 (Aug. 17)	Rodger Ward
*MILWAUKEE 200 (Aug. 18)	Jimmy Clark
*DARLINGTON 500 (Sept. 2)	Fireball Roberts
*DUQUOIN 100 (Sept. 2)	A. J. Foyt
*INDIANAPOLIS 100 (Sept. 14)	Rodger Ward
*MILWAUKEE 250 (Sept. 15)	Parnelli Jones
*TRENTON 200 (Sept. 22)	A. J. Foyt
*CHARLOTTE 400 (Oct. 13)	Junior Johnson
*SACRAMENTO 100 (Oct. 27)	Rodger Ward
*PHOENIX 100 (Nov. 17)	Rodger Ward

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Inventors' Corner

(Continued from page 34)

NEW PATENTS

Dental plates, jewelry and other small items can now be cleaned in their own miniature washing machine. The items are placed in a basket in top of the unit which oscillates around an upright axis. Patent 3,116,744 to Earl E. Hager of Riddle, Ore.

A helicopter which can be adapted for use as an automobile has been patented by Harold H. Sigler, San Mateo, Calif., and Joseph Stuart III of Palo Alto, Calif. On the ground, the rotor column blades and tail boom retract for road use. The device received patent 3,116,896.

Life is getting tough for fish. A tiny underwater beam developed by two Florida fishermen sends back sound signals from swimming fish, giving its location, size and speed. With practice, the unit even tells what kind of fish is being tracked. Patent 3,123,798 to Rollind O. and John R. Holloway of Hollywood, Fla.

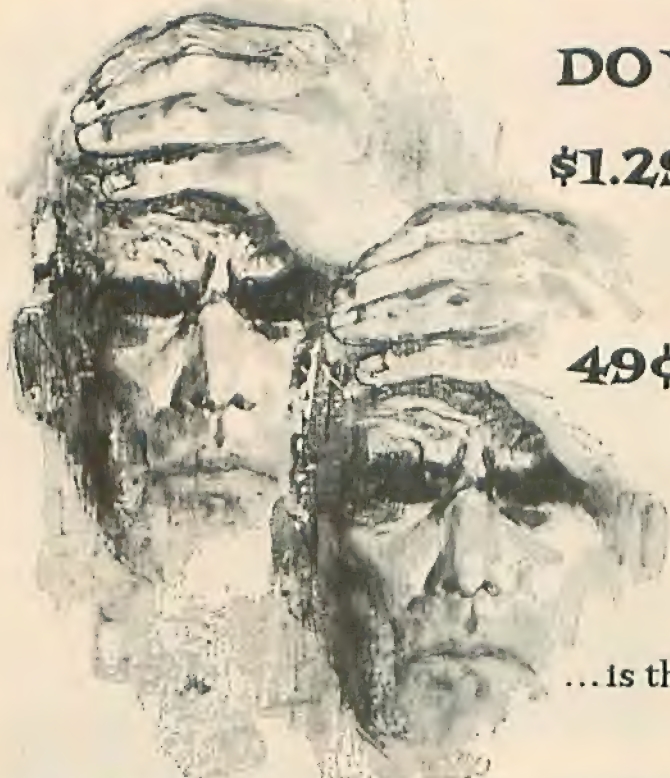
Snakes can be cleared from ground areas with a spray which won patent 3,117,058 for James R. Jenni of Oklahoma City, Okla. The toxicant kills snakes on contact but is not harmful to warm-blooded animals. In one test in Texas, it killed 240 rattlers, seven copperheads and a coral snake in three days.

Spare tires may soon be folded up and stored in a fraction of the space required for today's tire and wheel. When needed, they'd be unfolded, placed on the wheel and inflated. Patent 3,116,778 for the tires went to Frank Herzegh of Cleveland and James W. Pond of Doylestown, Ohio.

Chickens may soon face life in harness. A Swedish inventor, Hans E. Birch-Iensen, has developed a harness, patent 3,123,044, which fits under the tail of the chicken and keeps track of the number of eggs laid.

Collapsible boat can be folded up and carried inside an automobile, eliminating a trailer and garage storage. It supports an outboard motor, can tow water skiers and won patent 3,121,887 for Patrick A. Baretta of Oklahoma City, Okla.

Water skis which can be towed at relatively low speeds make use of the same technique, hydrofoils, that permit boats to skim across the top of the water. Patent 3,121,890 went to Joseph F. Rumsey, Jr., of Oklahoma City, Okla.



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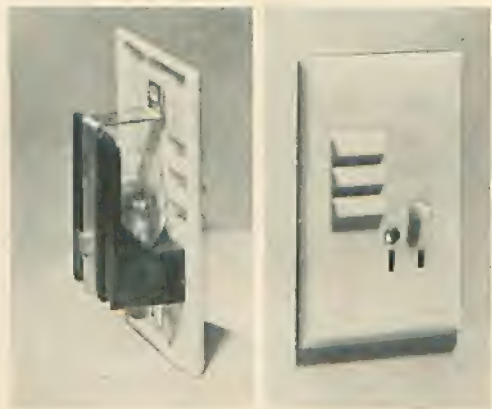
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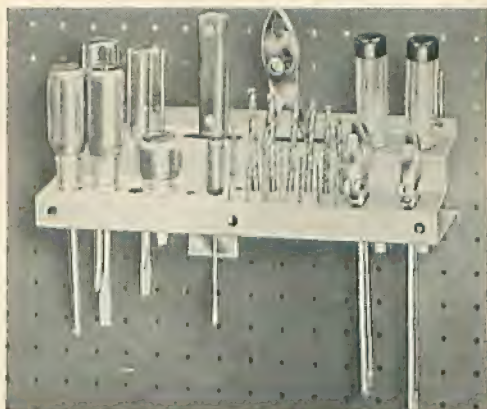
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TOOL RACK, trade named Spee Dee, is claimed by the manufacturer to be the first low-priced model (89¢) to feature a drill index. Holds 14 sizes of bit, from 1/16 to ¼ in. Two-step design permits convenient storage of a double row of tools. From Dalton Mfg., 30 S. Central Ave., St. Louis 5, Mo.

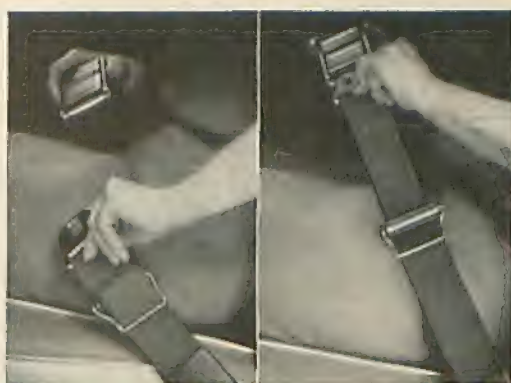


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


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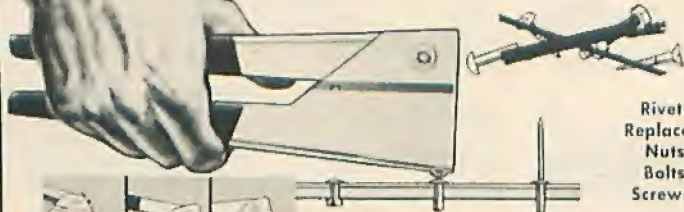
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ment. Free upon request from the Outboard Boating Club, 307 N. Michigan Ave., Chicago, Ill., the pamphlet also lists materials needed for each project.

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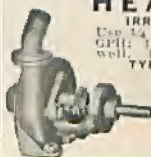
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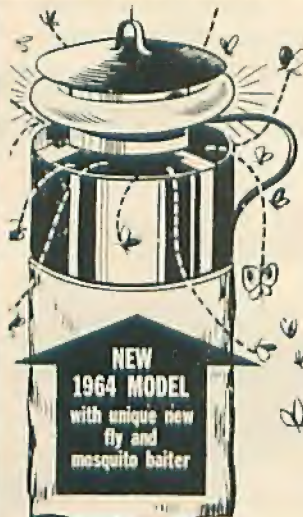
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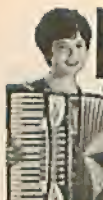
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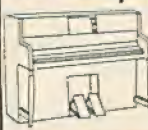
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as well as bucket seats; floor-mounted shift; wall-to-wall carpeting; vinyl upholstery; arm rests; cigarette lighter; room for four; sensibly sized trunk; sports steering wheel; courtesy lights; a 170-cu. in. Six . . . and more!

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INDY '64

First One-Pit-Stop, 155-MPH Race

New rear-engine cars, new tires, new power and new strategy make the 500 a brand-new race

By Jim Whipple

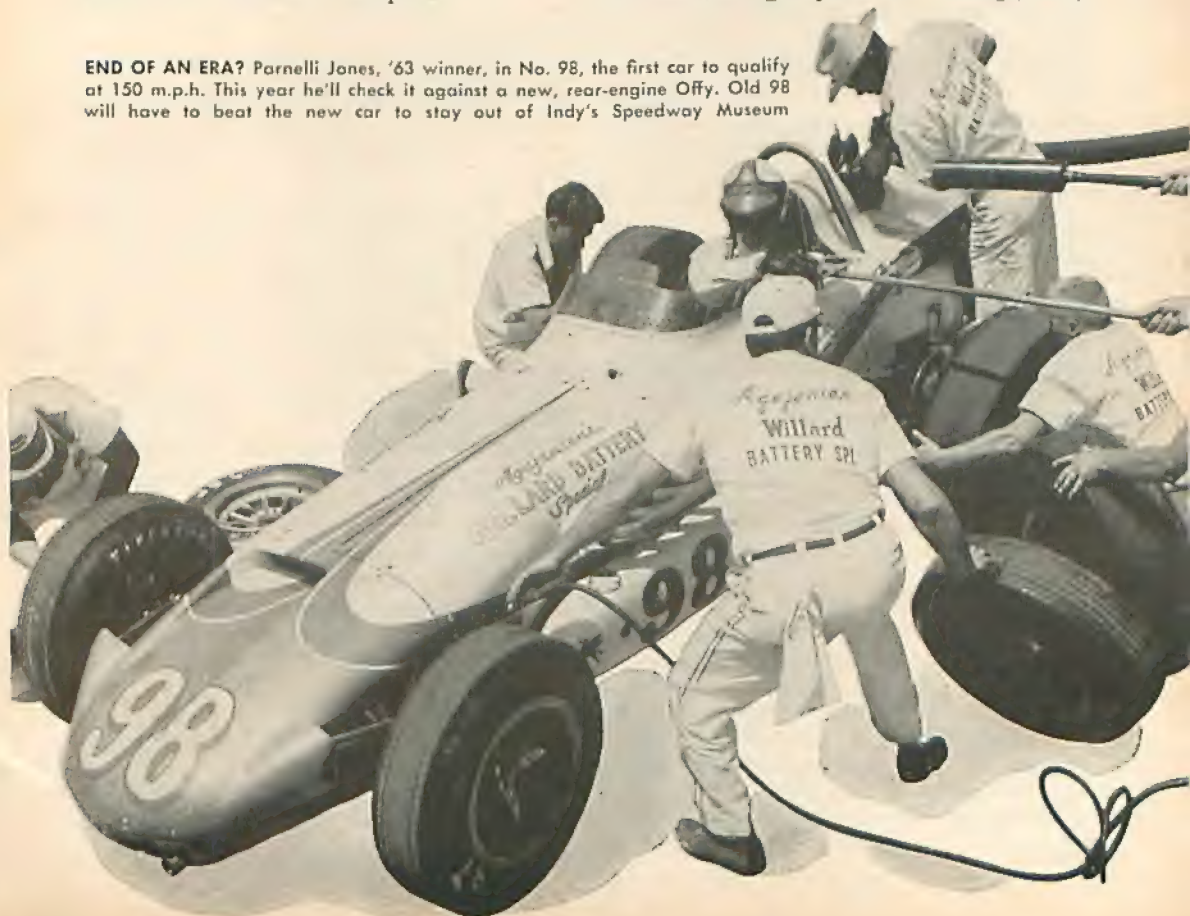
THIS IS THE YEAR of the big switch at Indy. And May 30th is the day when the old patterns of Indianapolis 500 racing will be knocked higher than a loose wheel nut on the far turn.

There was more than a hint of big changes to come last year, when young Jimmy Clark came within 24 seconds of winning his first time out at Indy, driving a slim, rear-engine Lotus against the beefy, front-engine Indy roadsters which have won so often in the past.

That was almost a classic David-and-Goliath race. The little Lotuses driven by Clark and Dan Gurney—each 400 pounds lighter than the conventional Offenhauser roadsters—were supposed to be too fragile to last 500 racing miles. But last they did, taking second and seventh place respectively.

The lessons were clear enough to drivers and designers alike. The lighter Lotus meant less tire wear; its smaller frontal area meant high-speed fuel savings, and,

END OF AN ERA? Parnelli Jones, '63 winner, in No. 98, the first car to qualify at 150 m.p.h. This year he'll check it against a new, rear-engine Offy. Old 98 will have to beat the new car to stay out of Indy's Speedway Museum





THE BOYS TO BEAT on May 30 are Lotus designer and team manager Colin Chapman (left) and World's Champion Driver Jimmy Clark, whose '63 second place left a host of unanswered questions. In '64, he gets 49 more horsepower

because the fuel itself was gasoline instead of an alcohol-benzol-methanol blend, less of it was needed. Pure gasoline gives 8 miles per gallon at Indy's 150-m.p.h. average speeds while alcohol blends yield only $4\frac{1}{2}$ to 5 miles per gallon.

All these factors mean a logistical advantage (in the race against time) for the Lotus. Stretching fuel and tires could eliminate one pit stop and save at least 20 seconds which could mean the difference between winning and second place. Tactically too, it developed, the Lotus' low CG, wide tread-design gave Clark and Gurney the priceless advantage of maneuverability. In negotiating the turns which loom up ahead of a driver four times each minute of the 200-lap race, that's important.

To maintain the blistering 150-m.p.h. average that prevailed last year (between caution flag periods), drivers of the turtle-backed Offy roadsters had to stay in the groove, the precise path that takes them up to the outside and down through the inside of each turn.

While the Offy drivers clung to the razor edge of tire adhesion, Clark and Gurney in their low, light, independently-suspended Lotuses, chose their routes through the traffic almost at will, lacking only added power to win in a walk.

This year they have that extra power.

The pressure put on the older, heavier cars by the new-style European road racing machinery in 1963 brought forth an exhibition of driving skill and sheer courage on the part of veteran Offy drivers that will never be forgotten by those who saw and appreciated it.

Somehow it was fitting that Parnelli Jones, winner of the pole position and fastest of the 1963 Offy drivers, should win what will probably be the last race in which the front-engined, heavyweights will dominate the starting field as well as the top 10 finishers.

But, the Offenhauser roadsters which won the battle last year seem to have lost the war.

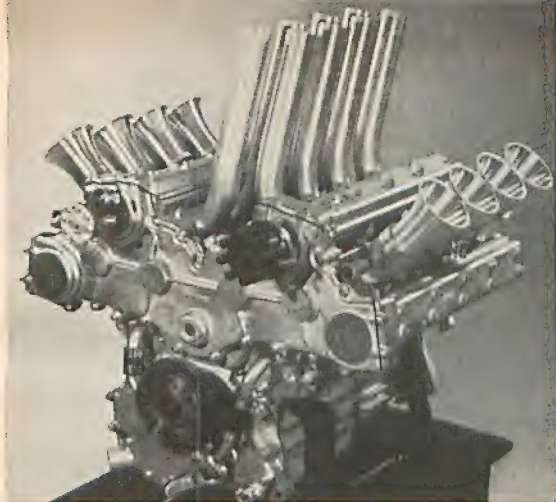
Just how completely they lost it is illustrated by the current plans of owner J. C. Agajanian to bring the "renewed" Watson-built Offy-powered #98 (Parnelli Jones' 1963 car) to the Speedway—along with a new, rear-engined Offy-powered car built by Troutman and Barnes. The new one has a slim, cigar shape and full-independent wheel suspension à la Lotus.

Parnelli will practice in each car and choose the one in which he feels that he'll have the best chance. If he drives the rear-engined job, his famous, front-engined No. 98 will be retired to the Indianapolis Motor Speedway Museum, as the first car in the history of the race to qualify at 150 m.p.h. plus.

At the moment there are about 15 Offenhauser-powered cars known to be in the 1964 qualifying process but more than half of them are rear-engined.

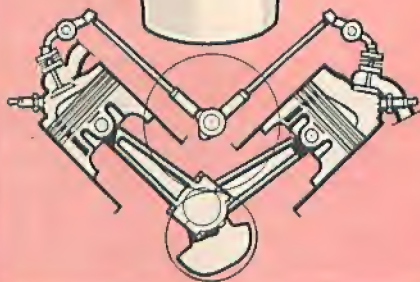
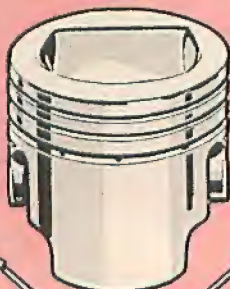
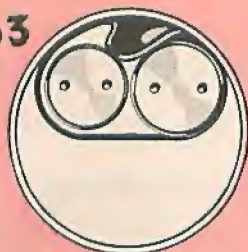
No less than eight Ford-powered cars are at the track and all of these are rear-engined.

The Lotus Ford car is the one to beat; there has been no doubt on that score since Ford Motor Company announced late last year that they were readying a dual overhead-camshaft version of the



THE FORD IN INDY'S FUTURE is this hot Fairlane-derived, aluminum V8 with four overhead camshafts

1963

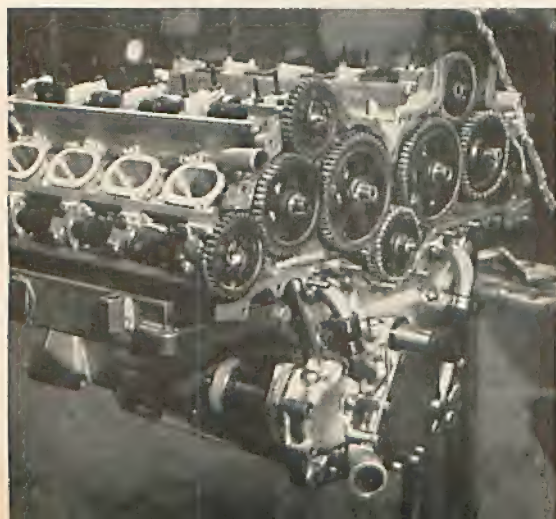


FOUR VALVES ATOP EACH cylinder give '64 Ford engines better breathing. Higher engine speed possible with overhead cams gives 13 percent more power from the same 255 cubic inches as in 1963

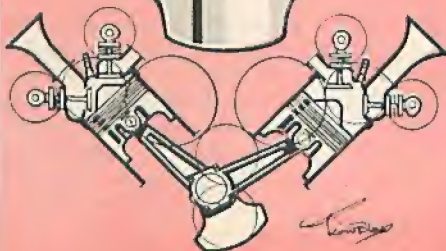
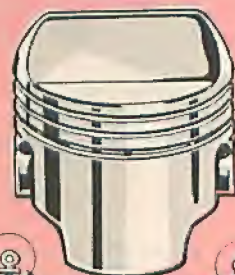
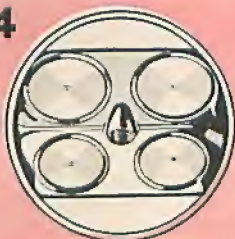


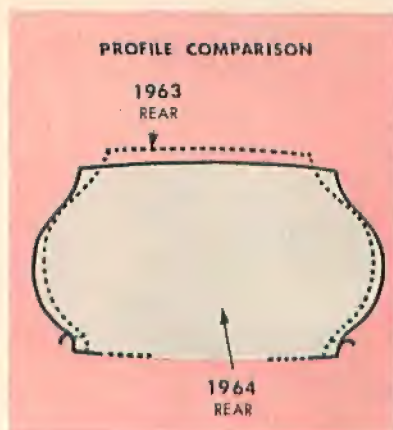
THE '63 PUSHROD V8 had four dual carbs instead of fuel injectors and developed "only" 376 horsepower

BUSINESS END of the '64 Indy Ford shows gear train for four camshafts to operate the engine's 32 valves



1964





A KEY FACTOR IN THE HIGHER SPEEDS expected from Indy '64 is the tires. New rubber compounds, new profiles, new tread patterns and cords are being counted on for better adhesion in the corners, longer wear for fewer pit stops

cast aluminum racing Fairlane V8 which powered the Lotus last year, while aspirating 103-octane gasoline vapor through four Weber dual carburetors and eight pushrod-operated intake valves. This '63 engine was reported to have developed better than 370 horsepower.

Now comes the new engine with its fearsome cluster of camdrive gears climbing up its front end like so much steel ivy.

This new Ford engine will breathe by virtue of *two* intake and *two* exhaust valves for each cylinder. Oval intake ports will feed from each of the eight Hillborn fuel injectors to siamesed intake valves of two-inch diameter, into a pent-roofed combustion chamber where a centrally located plug will fire the mixtures at 10.1 to 1 compression.

Gases will leave via twin 1.85-inch exhaust valves and ports which lead to the inner side of the cylinder heads where last year's carburetors were located. Exhaust piping will be simpler with the eight exhaust ports connected in appropriate pairs to exit at the rear of the engine in a horizontal plane.

The bottom end of the engine will be virtually the same as the pushrod '63 engine, with dry sump and gear driven oil pumps.

The '64 engine weighs about 400 pounds, up 40 from last year's job as a result of the extra hardware involved in driving 32 overhead valves. However, this extra weight pays its fare and then some as horsepower is increased from 375 to about 425 as a result of a 30 percent improve-

ment in breathing. Engine speeds required for the greater horsepower peak will run about 8000 up from the 7200 r.p.m. of the '63 engine. Ford development engineers are planning to limit the top engine speed in accelerating down the two main straights to a maximum of 8500 r.p.m.

In contrast, the Offenhauser engine cranks out its 400 horsepower at about 6500 r.p.m. Meyer Drake does not have to defend the reliability of their Offy—it rarely throws rods or fails in other vital parts. Biggest worry of the Offy owner is magneto failure. In spite of the best minds in the business the mag is still the headquarters for Indy gremlins that defy pre-race preparation and testing.

Ford's engines will not be plagued with mag failure. They will be using their own breakerless transistorized ignition.

In resistance to wear, both engines are about on par—the Offy turns perhaps 1500 r.p.m. slower than the Ford, but its longer piston stroke adds up to the same piston speeds.

Thanks to extensive use of magnesium on the part of Offy designer Leo Goosens, the big four can be brought down to about 475 lbs. Meyer Drake has been working hard to ready an all aluminum Offenhauser with light cast iron cylinder bores which would cut weight down to about 380 pounds—actually less than the 1964 Ford engine. As we go to press, it's almost certain that this version will be proved out in time for the race.

Thus, we see both the Offy and Ford close in output as well as design—both



COMPETITIVE PRESSURE from rear-engine Lotus entries crowded "old style" Offy-powered cars to frenzied efforts. Here Eddie Sachs, in the top ten as the finish line approached, loses a wheel on the turn. He was unscratched

have four-valves per cylinder and pent-roofed pistons.

One factor, however, makes the big difference. The Offy burns alcohol rather than gasoline and consumes it at a rate nearly twice that of the Ford-Lotus, 4½ miles per gallon versus 8. To complete a 500-mile race, the Offy-powered car will need about 115 gallons of fuel versus 62 gallons for the Lotus Ford.

It's true that the new rear-engined Offy cars will have smaller frontal areas and hence less wind resistance. But they should be traveling at faster speeds, so fuel consumption may remain about the same.

It is possible for the Lotus-Ford to run the race on one load (about 400 pounds of fuel); the Offy will need almost double that load. The weight penalty of a fully-loaded Offy during the early part of the race would cut time from each lap so that time lost on the track would equal the time needed for a single pit stop.

Experts estimate that a fully loaded Offy would be ½ to 1 second slower during the first 50 to 100 laps. And a half loaded Offy would be perhaps two minutes ahead of his fully-loaded rival at midpoint in the race. But a long pitstop for both fuel and tires would cost only a minute. Thus theoretically, the refueled car would still be a minute ahead of the nonstop entry.

Incidentally, it would be impossible for the front-engined Offy roadsters to run a nonstop race because the fuel is carried at the rear end of the car.

As the race progressed, the removal of some 800 pounds from the rear of the car would change the handling characteristics drastically. The rear-engined cars carry their fuel in tanks amidships which does not disturb the balance of the car as fuel is consumed. It is lightened equally on all four wheels.

Dan Gurney, who will be bringing two Lotuses to the track, is seriously considering the nonstop strategy.

Tire Wear Breakthrough

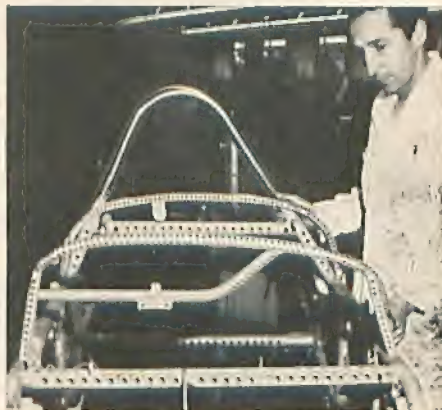
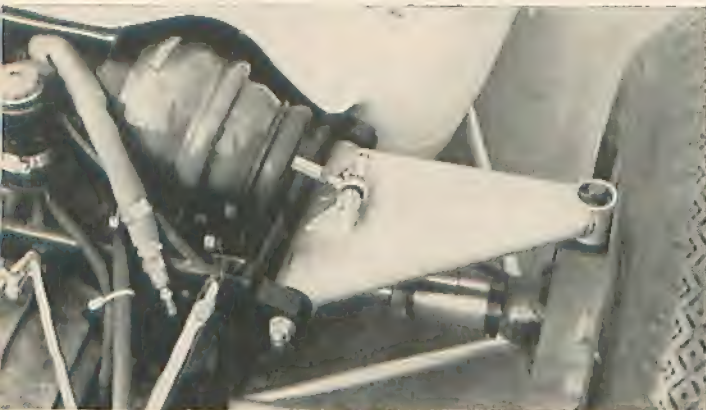
What makes the concept of the nonstop race possible at all is the breakthrough in tire design which has come in the past year. Both major companies who offer tires for the race—Firestone and Good-year—can guarantee well over 500 miles at racing speeds and in the heavier cars as well.

Tires are similar in design in that both are wider to get more tread on the road.

Firestone claims that its tires have more stability, less roll as a result of new lightweight nylon construction, minimum shoulders for less heat and longer wear.

Basic claim is that tires are a full five miles per hour faster than the 1963 race tires.

A group of drivers, including two-time Indy winner Rodger Ward, ran extensive tests with the new tires on old front-engined Offenhauser roadsters at the track last summer and fall. All agreed that the new designs had much better control. Said one, "I found that I could only turn 142 miles per hour on the old design, and I



MG LIQUID SUSPENSION SPECIAL, top, has fluid-filled rubber donuts acting as springs, is powered by rear-mounted Offenhauser engine, will be driven by '61 winner A. J. Foyt. Hydralastic suspension unit shown at left above. Engineer Vince Granetelli, above right, drilled 26 pounds from Novi's frame

could go 10 m.p.h. faster with the new design." Another said, "The car got a little loose when running on last year's tires at 150 m.p.h. But with the new tires I drive right into the corners and am 100 percent under control."

Goodyear feels equally confident about its new tire. Incidentally, this will be the first time that Goodyear has offered a tire designed for Indianapolis. According to Tony Wenda, head of Goodyear's racing tire development, A. J. Foyt ran 100 miles at an average of 150 at the Speedway last summer in the hottest weather and measurement of wear showed that the tires would be well able to finish a 500-mile race under the toughest conditions.

Tire strategy and fuel strategy are closely linked together for the '64 race. If a team plans for the single pit stop, says Wenda, they may seriously consider a tire change, too. For with tires not designed

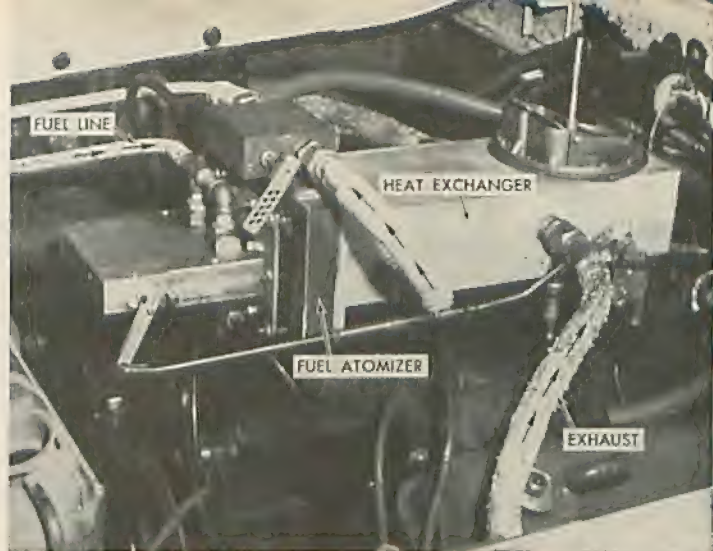
to go the full 500 miles, a slight increase in speed can be expected. In other words, the long haul tire is just a bit slower. How much slower is strictly a matter for Goodyear and its racing customers to know at this time.

United States Auto Club officials huddled with drivers and owners to settle on a maximum of 16-inch wheel diameter and a minimum of 15 inches. The 12-inch roller skate wheels run by the Mickey Thompson entries last year are taboo.

Those familiar with the performance of these new tires agree that they will speed up the cars, regardless of design. So it is extremely doubtful that any of the final qualifying 33 racers will have qualifying speeds of under 150 m.p.h. By the same token, say the experts, you can expect the pole position (won by fastest qualifier) to hold a driver who has posted a speed

(Please turn to page 222)

AFTER EXHAUST gases enter a heat exchanger, warming the spray of fuel from the atomizer, they mix with the fog of fuel. The combination mixes with air before getting to the intake manifold



Ring-Saving New 'Carb' Also Cuts Knocks and Smog

A 50-PERCENT CUT in piston-ring wear and a "substantial" reduction of combustion-chamber deposits are claimed as bonus results of a new smog-control device being road tested by the University of California, Los Angeles.

Essentially, the system combines an atomizer with an exhaust feedback circuit so about a fifth of the exhaust gases are ducted round the atomizing chamber to heat it, then are fed into the chamber to mix with the fog of atomized fuel. The combination, with air flowing in from the air cleaner, enters the intake manifold as a homogenous mixture. The atomizer replaces the conventional carb.

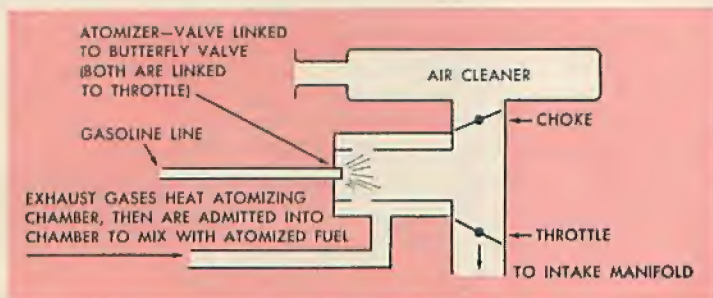
Octane need is down, too. The device is claimed to let most high compression

engines run knock-free on regular gas.

How about its effect on smog? Nitrogen oxide was reduced 80 percent, carbon monoxide down 70 to 90 percent, unburned hydrocarbons down 50 to 60 percent.

Earlier attempts at recycling exhaust gases were plagued with power surges, sudden speed changes that couldn't be controlled. The atomizer, working something like a paint spray nozzle, has overcome that problem. Developer Richard Kopa says the device, at a cost comparable to a good, four-barrel carburetor, could be installed on existing engines as well as new production. Indications are that economy will be about that of an ordinary carb in good shape. The system isn't yet on the market.

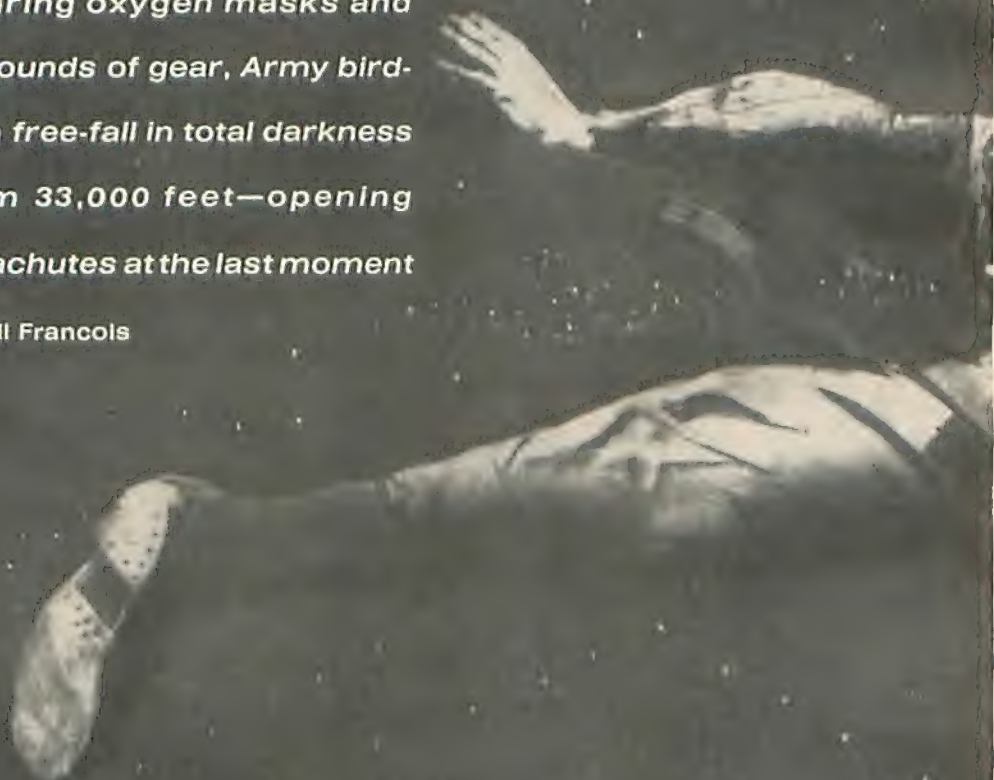
SIMPLIFIED diagram shows operation of the heat exchanger in a fuel system that replaces conventional carburetors for better combustion, less ring wear, sharply reduced smog. UCLA scientists are road-testing device



Midnight Sky

Wearing oxygen masks and 80 pounds of gear, Army birdmen free-fall in total darkness from 33,000 feet—opening parachutes at the last moment

By Bill Francols




CLIMBING through the shroud of darkness, a four-engined aircraft labored toward the spot nearly seven miles above the earth where the final test of "Operation HALO" would begin. There was no moon. But stars glittered against the black velvet dome of space. Eight men, clustering near the open doorway of the huge C-130 transport, were about to make or break the Army's newest concept of infiltrating unseen and unheard into enemy territory.

Their faces were covered with oxygen masks and bulging goggles. Their bodies looked grotesque under the bulk of heavy equipment and parachutes. A red light, glowing above the doorway, cast weird shadows across their masks as the air-

borne pioneers waited for an Army sergeant to lead them into a spine-tingling 180-second free fall through the black void—an eternity of minutes. If the plunge from 33,000 feet succeeded, a new kind of special warfare would take its place in America's arsenal.

On the ground, in the wilderness boondocks of Ft. Bragg, N. C., infantrymen listened and watched for the sky invaders. They already knew where and when the attack would occur—information that no real enemy of the United States would possess. Although their eyes and ears failed to detect the high-flying plane, the footsloggers were confident of putting Operation HALO (High Altitude Low Opening) back on the

Divers



SPREAD-EAGLED, birdman plunges in silent darkness to pinpoint spot more than 30,000 feet below. With arms and legs outstretched, he controls body during 120-m.p.h. fall until chute opens at 2000 feet

ARMS LOCKED, four more members of Operation Halo leave high-altitude plane. After they disengage themselves, white helmets and small lights mounted on them will keep them close together during fall



Army's shelf of harebrained schemes. Their radar already was tracking the plane. What the operators of those electronic eyes did not see were dust-sized specks that represented human bodies plummeting in an opposite direction from the airplane at speeds up to 150 m.p.h., and in total silence.

William Edge, a 33-year-old master sergeant who has more than 1000 jumps to his credit, was the first to leap into the darkness. His plummeting body quickly decelerated to a stabilized free-fall velocity of 120 m.p.h. The remaining seven members of the HALO group followed and soon achieved belly-to-earth body positions.

Down they plunged, legs and arms outstretched, their flight suits flapping in the rush of air. Wind tore at their oxygen masks and whistled past their ears as their eyes searched for the flickering amber light mounted on Edge's jump helmet. Their own helmets were equipped with white lights—beacons invisible from the ground—that guided the sky soldiers into squad formation.

Each man was like an airplane. With arms held backward in delta-wing position, downward speed could be rapidly increased. Long hours of training had made it possible to turn the body in any direction, to loop-the-loop, to track across the

WELL-DRESSED birdman carries 80 pounds of equipment, including two chutes and rucksack, yet he can still maneuver body during 6-mile, 3-minute fall



AIR SHOWS, in daylight, give special forces chance to show how they do it. Smoke grenades on heels of boots allow spectators to follow them down to earth



sky in a lateral arc, to play a deadly serious game of follow the leader. The free-falling daredevils swooped down on their "enemy" like a formation of night hawks swooping on an unsuspecting prey.

Sergeant Edge led his birdmen two miles laterally from the point of exiting the aircraft. Luminous dials on the altimeter anchored to his emergency parachute clocked off the fast-closing distance to the earth's surface. When only 2000 feet of cushion remained between him and a sticky end, the veteran parachutist yanked hard on the ripcord. Nylon streamed from the back pack, then popped open to lower him gently to the ground. The other HALO testers landed within 100 yards of their leader. Mission complete.

"An incredible accomplishment," one observer said. "We didn't hear or see a thing."

Trained soldiers, free falling at night from altitudes never before attempted, cannot be detected except by the most sophisticated radar network. More than 80 percent of the world's land mass can be secretly penetrated by HALO-trained birdmen. Neither the soldiers, nor the aircraft carrying them, are vulnerable to most kinds of ground fire. Conventional paratroopers, bailing out of slow-moving transports at low altitudes practically

within range of slingshots, are like clay pigeons in a shooting gallery.

Experimentations that led to the Army's acceptance of HALO first began in December, 1957, when a handful of men from the 77th Special Forces Group at Ft. Bragg started to test the concept.

By late 1963 four groups of about 24 men had become HALO birdmen by completing one of the most unusual training programs in the military services.

Their first day in the classroom is a memorable one. They find themselves being measured by the frosty eyes of Sergeant Edge, who wears glasses and stands a stocky five-foot seven-inches tall—a half-inch shorter than he used to be because of a broken back. That injury occurred while he was a record-setting member of the famed U.S. Army Parachute Team. If the bull-necked noncom looks indestructible it's because he's lived through three plane crashes and survived the wounds of Korean War battles. Most of the other HALO committeemen are veterans of pain and injury, too.

His buddy, Sgt. 1/C Wilfred "Squeak" Charette of Providence, R.I., is partially held together by pins and wire as a result of a spectacular crash of a C-123 moments after takeoff at a Wilmington, N.C., air

(Please turn to page 216)

CHUTES DEPLOY at 2000 feet. Early problem was to wean birdmen from "umbilical cord," static line which opens chute automatically in low-altitude jumps



SKY-HOOK PROGRAM reverses HALO. Man is lifted from ground and carried aloft by aircraft. Harness is hooked to balloon by cable and plane snags cable



**PM
OWNERS
REPORT**

**A Nationwide
Survey Based on
1,191,203 Owner-
Driven Miles**

Ford's Big Ride



ALTHOUGH the majority of Ford owners hailed trunk area, with its tucked-a-way spare, as generous, some owners felt it was too small



Outweighs Gas Mileage

*Marginal and boldface comments by Jim Whipple,
PM's Automotive Editor*

FORD HAS MOVED AWAY from the 'tin' type vehicle," says a California police officer. "It now has the riding comfort of a large car."

An oil well pumper from Texas seconds the motion by saying: "The '64 Ford drives and handles better than any Ford ever made. It performs like a heavy car and has a body second to none." But a mill supervisor from South Carolina is not so sure. He puts it this way: "I think Ford's engineering department has developed an exceptionally fine car, but the production department is losing some of that quality during assembly. My car has been back to the dealer for three full and two half days to correct minor items."

However, the major complaint voiced by Ford owners was about poor fuel mileage, not workmanship. While some 55.1 percent of all owners reporting felt that mileage was about as expected and 14.8 percent felt that it was better, 30.1 percent said that their Fords were not delivering the miles-per-gallon that they'd anticipated.

Most owners had V8 engines and got between 9 and 14 miles per gallon in city traffic and between 14 and 18 on the open road.

PM ran constant-speed fuel mileage checks on a Galaxie four-door hardtop with 353-cubic-inch, 250-horsepower



ROOMINESS AND COMFORTABLE SEATS are features that Ford owners like, but many were plagued by dash lights jiggling from their mounts



Owners Like

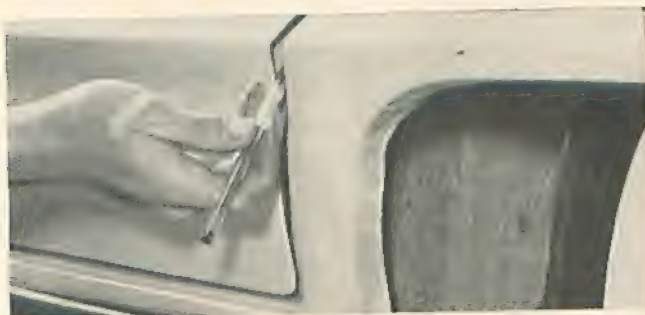
Plushy ride	(41.8%)
Fingertip control	(41.4%)
Hot performance	(30.7%)

and They Dislike

Disappointing mileage	(14.8%)
Whistling winds	(10.7%)
Loose dash lights	(9.0%)



ATTRACTIVE DASHBOARD and its soft, non-glare lighting drew praise from the Ford owners reporting to *PM* readers about their new cars. Instrument cluster on test Galaxie was hooded and well padded



GAP BETWEEN DOOR and body metal on the test car is the sort of thing owners complained about as "poor workmanship" and "badly fitting door." It might explain the wind noise complaints



Most owners had the standard V8 of 289 cubic inches, 2-barrel carburetor, which explains their comparatively good trip mileages in contrast to *PM*'s constant speed runs in a bigger sized 352 c.i.d. V8 with 4-barrel carb

engine with 4-barrel carburetor. Here are the results:

30 m.p.h.,	20.06 miles per gallon
40 m.p.h.,	19.18 miles per gallon
50 m.p.h.,	18.15 miles per gallon
60 m.p.h.,	16.30 miles per gallon
70 m.p.h.,	13.49 miles per gallon

Our over-all fuel mileage was 15.8 for mixed country, turn-pike and stop-and-go driving.

Testing the acceleration with the Tracktest electric speedometer showed: 0 to 60 m.p.h., 12.3 seconds; 40 to 60 m.p.h., 7.3 seconds; 50 to 70 m.p.h., 7.7 seconds; 0 to 80 m.p.h., 20.5 seconds; and 18.5 seconds for the standing-start quarter mile.

Now let's turn to the reports from the owners themselves. Here are selected favorable comments on typical "Best-liked" features of the '64 Ford, mentioned in order of their frequency.

"I like its superior riding quality. It seems to fly over the bumps."—Pennsylvania bookkeeper.

"Has the best ride of any car I have ever had."—Montana salesman.

"The handling and ride you get makes you feel as if you are driving one of the bigger cars."—Missouri steelworker.

"Handles extremely well on sharp curves."—Maine postman.

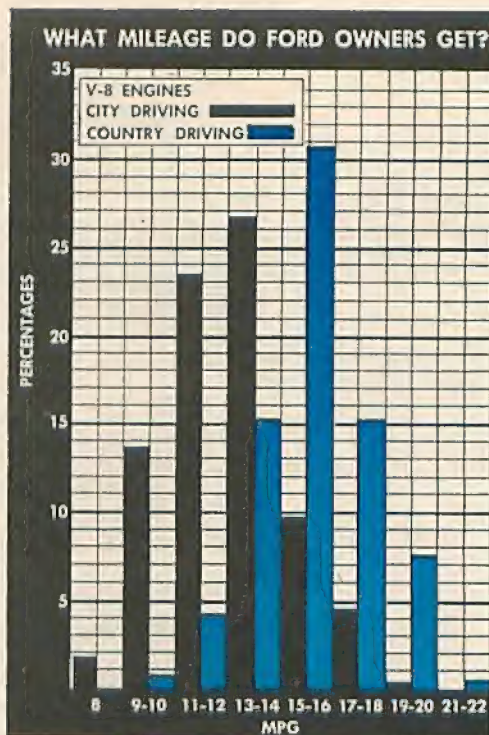
"The steering is better; it is a pleasure to drive."—Ohio job welder.

"It rides like a dream and handles like a charm."—Virginia sales trainer.

"A Cadillac owner drove in one day last week. He com-



DRIVER SPACE IN THE GALAXIE isn't at the expense of rear-seat kneeroom. Luxurious upholstery was first among the interior features PM owners liked



HIGH FUEL CONSUMPTION led the list of specific complaints by Ford owners, but 55 percent felt that mileage was about what they'd expected

mented that maybe I could convince him to buy a Ford. This car handles well, even on graveled country roads."—Minnesota salesman.

"I like the pickup I have when I go to pass someone."—Kentucky carpenter.

"It's responsive and has good acceleration."—Maryland systems analyst.

"The over-all design is beautiful; I love the 'fast back.'"—Illinois manager.

"Most station wagons look like bulky trucks. Ford's wagon is styled similar to nice looking cars."—Kansas lumberman.

"The body sounds solid."—Minnesota salesman.

"I like the lack of road noise inside the car; the total 'solid feeling.'"—Virginia chemist.

To balance the glowing words of praise, here's the debit side of the ledger—owners' complaints numbering one through five in the order mentioned most often.

"The gas mileage for the 252-V8-standard transmission is not as good as I expected."—Connecticut postal clerk.

"I thought the gas mileage would be better. I get 10-11 m.p.g."—Illinois steamfitter.

"There is no reason why the '59-'61 Fords should get such good mileage and the '62-'64 should decrease 4-6 miles per gallon."—Minnesota grocer.

"The 12 m.p.g. over-all gas mileage is not good and the carburetor was adjusted at about 2200 miles."—South Dakota farm equipment dealer.

For that price he could buy two Fords!

Everybody loves it. The fastback is the greatest thing that's happened to Ford styling since they took off the running boards

There are two good reasons—more weight and generally bigger engines

PM found wind whistles in its test four-door hardtop as speeds increased above 65 m.p.h. →

This is ridiculous! → They're taking too many coffee breaks in the quality control section

Ford is a very roadable car, although PM found that springs bottomed when taking sharp rises at higher speeds →

"My convertible has a loud shrill whistle sound from the windshield."—Massachusetts tailor.

"Wind noise is terrible. I'm unable to carry on conversations in the car without shouting."—Florida banker.

"There is too much wind noise at speeds above 60 m.p.h."—Illinois technician.

"The windows whistle; there are noises above the doors and windshield."—Minnesota miner.

"The bulb falls out of the holes behind the dash."—Illinois electrician.

"The dash lights will not stay in the dash. They pop out of the holes."—Kentucky paint mixer.

"In my convertible, visibility is very limited to the rear."—Kentucky insurance agent.

"The bumpers are beginning to show signs of corrosion."—Michigan buyer.

"The high hood and high rear window cuts down visibility forward and rear."—Connecticut tool coordinator.

"It was delivered to me in a very poor condition; the hood was sprung, the trunk had to be repainted and the undercoating was slopped over."—New York electronics supervisor.

Back to the bright side, here are the owners' "Best-liked" comments six through ten in order of frequency mentioned.

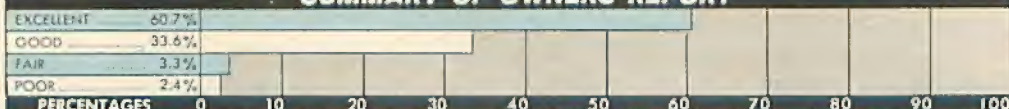
"It drives a lot better than my '62 Ford did."—Iowa salesman.

"Very smooth driving on the open road. Also holds the road well."—Illinois pipe organ builder.

"There's no sway or pitching at highway speeds of 60 to 80 m.p.h."—Ohio factory worker.

(Please turn to page 212)

SUMMARY OF OWNERS REPORT



Mileage experience	
About as expected	55.1%
Better than expected	14.8
Not as good	30.1
Best-liked features	
Riding comfort	41.8
Handling ease	41.4
Power, performance	30.7
Styling	30.3
Solid, rattle-free body	13.5
Roadability	11.5
Specific complaints	
None at all	32.0
Poor gas mileage	14.8
Wind noise	10.7
Panel lights fall out	9.0
Poor vision to rear	5.3
Generally poor workmanship	5.3
Mechanical trouble, if any	
No mechanical trouble	70.9
Automatic transmission	3.7
Carburetor	3.3
Power steering	2.4
Automatic choke	2.0
Brakes	2.0
Best-liked exterior features	
Clean, uncluttered lines	8.2
Roof line	6.6
Paint finish	4.9
Trim, sleek, smooth styling	4.5
Grille	4.5
Colors	3.7

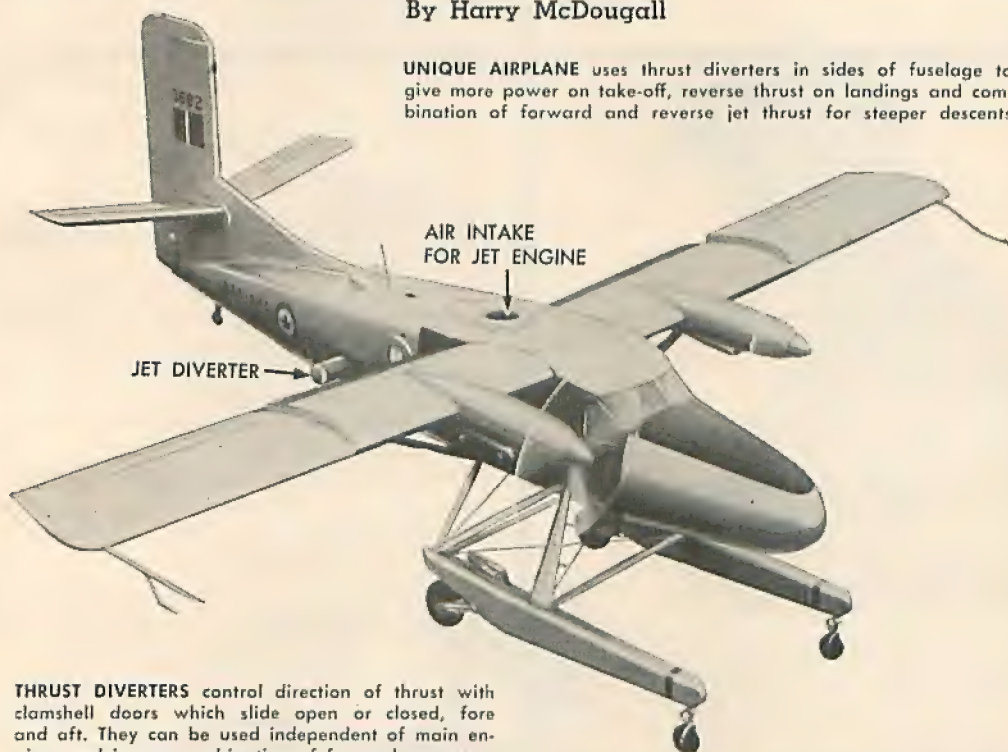
Least-liked exterior features	
Rear end	3.3%
Side chrome trim	3.3
No protective molding	2.0
Grille	2.0
Best-liked interior features	
Upholstery	22.1
Dashboard	12.3
Comfortable seats	11.9
Trim	4.9
Dashboard lights	4.9
Least-liked interior features	
Glove compartment	8.2
Drive shaft hump	5.7
Uncomfortable seats	4.9
Lack of headroom	2.9
Decision on Ford influenced by:	
Previous Ford ownership	48.0
Price, trade-in	28.1
Styling	27.9
Dealer	18.4
Performance	11.1
Riding comfort	4.9
Economy	4.5
Other full-size make considered	
No others considered	45.1
Chevrolet	31.2
Pontiac	8.6
Oldsmobile	4.9
Buick	4.5
Plymouth	3.7
Dodge	2.5

Compact make considered, if any	
None considered	89.8%
Ford Falcon	2.9
Comet	2.0
Buick Special	1.6
Corvair, Chevelle	1.6
Is Ford family's only car?	
Yes, it is	61.6
No, it isn't	38.9
Make of other car in family	
Another Ford	23.4
Other Ford Motor make	2.9
Chevrolet	4.1
Other General Motors make	4.5
Plymouth	2.4
Other Chrysler Corp., make	0.8
How is dealer service?	
Excellent	53.1
Average	40.2
Poor	6.7
Would you buy from him again?	
Yes, would buy	70.1
No, wouldn't buy	7.0
Make of car traded in	
Ford	61.2
Other Ford Motor makes	6.6
Chevrolet	6.6
Other General Motors makes	6.6
Chrysler Corp. makes	3.3
Would you buy another Ford?	
Yes, would buy	84.4
No, would not buy	4.5

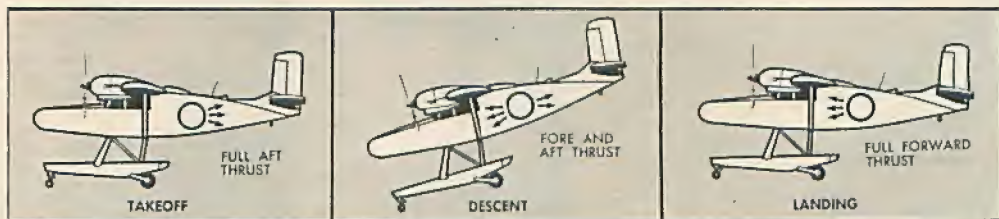
Prop Plane with a Jet Inside

By Harry McDougall

UNIQUE AIRPLANE uses thrust diverters in sides of fuselage to give more power on take-off, reverse thrust on landings and combination of forward and reverse jet thrust for steeper descents



THRUST DIVERTERS control direction of thrust with clamshell doors which slide open or closed, fore and aft. They can be used independent of main engines and in any combination of forward or reverse



CANADIAN ENGINEERS have developed a system for getting extra thrust in flight—either forward or reverse, or both—-independent of the main engines. It gives the plane extra forward thrust on take-off, a steeper rate of descent by using forward and reverse thrust at the same time, and shorter landing distances by using reverse thrust. In effect, it has made an ordinary plane into an STOL.

The test plane is a DeHavilland *Otter*. Ordinarily a single-engine plane with a tailwheel, the *Otter* was converted to a twin-engine and fitted with special pontoonlike gears to explore unorthodox landing techniques.

A jet engine is installed in the fuselage, with its air intake just aft of the high wing. Diverters project from the sides of the fuselage, and each diverter is fitted with clamshell doors which slide open or closed, controlled from the cockpit.

For take-off, all the jet thrust is directed aft by opening the rear clamshell doors and closing those in front.

For landing, all the jet thrust is directed forward. For steep descents—over high obstacles—both thrusts are used proportionately. The pilot sets flaps and reduces engine power, then controls descent by controlling the forward and aft thrust all the way up to 100 percent either way.

*Two Air Force experiments
may destroy old rules about
how much a man should weigh*

HOW MUCH

By Kevin V. Brown

BREATHES THERE A MAN with paunch so slender who never to himself has said: "I wonder if I'm putting on too much fat?"

But that's the rub. How much is too much? No doctor can tell him—not exactly. He can use the standard weight tables based on age and height, but he can't say to any one individual that he is carrying *exactly* so many pounds and so many ounces of excess weight. Wouldn't the men—and, especially, the women—of the world love to have that figure!

Well, now it's possible. The unlikely source of this revolutionary new and precise information is the United States Air

PM EDITOR gets weighed (left) and ducked in water tank (below) to get his weight and volume in Air Force test



EXCESS FAT DO YOU CARRY?

Force. In two separate experiments it may be exploding all the old rules and myths of how much any man should weigh at any given age. Think of the consternation this may cause in doctor's anterooms, insurance offices and reducing salons!

The Air Force's purpose, of course, is selfish. It has a lot of money invested in its personnel, especially its highly trained flight crews. At their annual physicals, some of them are grounded by flight surgeons—and even separated from service—because, according to the age-height-weight tables, they're "overweight." Many consider these tables inaccurate, arbitrary and obsolete. So the Air Force, at its

School of Aerospace Medicine near San Antonio, Texas, is trying to find a more scientific basis for establishing an ideal weight for each officer and airman.

Neither of its two experiments has been officially adopted, but both show promise even though they are about as far apart as the first and last pages in a history book. One is based on an experiment tried before the time of Christ, and the other is a product of the atomic age.

The first method involves a principle laid down by the ancient Greek mathematician, Archimedes, and brought up to date by Dr. Thomas H. Allen, civilian chief of the Aerospace School's physiology section.

WATER TANK measures volume of human body by amount of water it displaces as read on gauge outside tank. Body weight and volume are then compared

CLOSED-CIRCUIT breathing apparatus tells how much air lungs contain so amount can be subtracted from total body volume. Only major elements are measured



Archimedes' king had been given a gift of a gold crown. Suspecting the giver, the king asked Archimedes if he could determine, without destroying the crown, whether it was pure gold or whether it had been "leaded" with inferior metal.

Gold was then the heaviest metal known, so Archimedes knew that, size for size, it would take up less space for the same weight than any other metal. If the crown was pure gold, it would have the same volume as pure gold of the same weight; if it included some other metal, it would have a larger volume than pure gold of the same weight. But how to measure the volume? This was his great discovery.

He took some gold that he knew to be pure and got it up to the same weight as the crown. Now with both the same weight, he put each separately into a pail full of water and measured the amount of water they displaced. In each case, the volume of the displaced water should equal the volume of the mass he was measuring.

The results of Archimedes' experiment have long been forgotten, but the principle he discovered has survived. If the density of any material is known, a relationship between its weight, as measured on a scale, and its volume, as measured in water, can be established.

Dr. Allen and his group have translated this principle into measurement of the human body. The weight is measured on a normal scale and the volume is measured in a specially designed water tank—the

only one in the United States. The relationship between the two is established with an exceedingly long and complicated formula worked out by Dr. Allen (it goes on for more than three typewritten pages, single spaced), but it is based on the known densities of the major elements of the human body (water, bone mineral, body protein and fat).

The significant thing for the layman to remember is that the lean body weight (water, mineral and protein) is much more dense than fat body weight, so fat weight is much lighter. Capt. Eugene Degner, one of Dr. Allen's associates, said, "If you could hack off some fat from a body and throw it on water, it would float. It's that light."

So, size for size, lean weight will weigh more than fat weight. Weight for weight, fat weight will take up more space than lean weight. And, in a man, it is the relationship between his fat weight and his lean weight that determines overweight, not just his age, height and *total* weight. Dr. Allen (he's a Ph.D, incidentally, not an M.D.) believes that no more than 15 to 20 percent of a man's total weight should be fat, with the remaining 80 to 85 percent lean weight. Well-conditioned athletes carry 15 percent fat or less. Some fat storage is necessary for good health, but if it gets above 20 percent it's excess.

See how this affects the old age-height-weight charts, which measure a man in only one direction (his height) and ignore the relationship between his fat weight

RADIOACTIVE WATER is drunk in second test. After it is assimilated in body, blood sample is taken and water separated from it (right). Proportion of radioactive water in measured sample will give total body water and, by formula, total lean weight and fat weight



and his lean weight. Take two men of the same age and height, both weighing 200 pounds. One has a lean weight of 170 pounds and fat weight of 30 pounds—or 15 percent. The other has a lean weight of 150 pounds and fat weight of 50 pounds, 25 percent. The first man is obviously in perfect condition and the second obviously overweight, yet according to the charts they should be treated alike. In the water tank, however, the overweight man's larger volume would show up.

Reverse this. Take two men of the same age, height and volume, meaning they displace the same amount of water in the tank. Yet, on the scales, one weighs more than the other. According to the charts, he could be considered overweight. But the reverse is true. If both have the same volume, both should weigh the same on the scale unless one has more lean weight and the other more fat weight. The lean weight will weigh more, because it's solid, and the fat less, because it's flabby.

Stocky, football-player types get penalized the most on this basis, because they carry a proportionately higher volume of lean weight for their size, and it is just these types that the Air Force is trying to save from the injustices of the old weight charts. Dr. Allen objects to these charts on another count. They allow a man as he grows older to add more weight. This, he says, is wrong because as a man grows older he becomes less active and has less need for storing fat. He thinks a man

should take off weight as he grows older, or at least try to hold the level he had when he was 21 or 22 years old.

The problem, he says, is that the standard weight charts are based, not on what a man ought to weigh, but are statistical averages of what men actually *do* weigh. He says he can't blame the insurance companies for following these tables, because insurance companies are not idealists but realists. They pay off on what exists, not on what ought to be. He's a little put out, however, with doctors who allow their patients to add weight as they add years. The excess fat is not only unnecessary, he claims, but a burden.

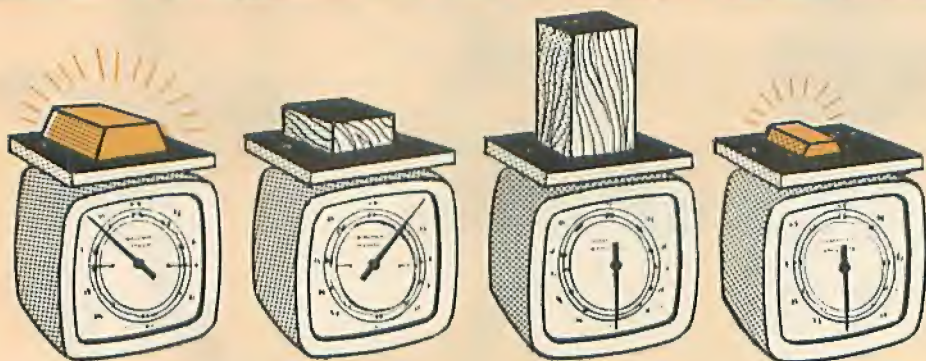
"It's a shame," is his summation, "that as we grow older our appetite for food always exceeds our need for it."

But let's get back to the tank—or into it. Here's how the tests are conducted: The subjects report early in the morning, preferably without breakfast, because bodily gases are at their lowest then. The men are asked to shower and make a bowel movement to eliminate as much extra weight and intestinal gas as possible. They are weighed nude, and this figure is noted.

Next, each man enters the tank, again nude, from the top. An electrically driven motor lowers him to the bottom on a small platform. The water level is just below his chin and, before he ducks all the way under, he exhales as much air as he can. While he is under, his total body displace-

(Please turn to page 200)

LEAN AND FAT weight are like gold and wood. If same size, block of gold weighs more than wood. If same weight, wood is much larger than gold. Substitute lean for gold and fat for wood and you will understand basis for water-tank tests. Lean is dense and heavier; fat is light and larger



Fireman,

...

One of baseball's great relief pitchers tells how he and a handful of other late-inning artists rescue games for starting hurlers

By Dick Radatz
of the Boston Red Sox

PICTURE THIS. A group of "specialists" in white uniforms serving up big white "pills" in a pen designed for bulls. Got it? If you have, chances are you're a baseball fan. Firemen like Elroy Face, Stu Miller, Jim Brosnan, myself, and a fistful of others in both leagues are "specialists" on emergency call. The emergencies come thicker and faster every baseball season.

We're the relief pitchers. Great starting pitchers of yesterday like Bucky Walters now insist that we're the most important men on our ballclubs. If it's true, we haven't always been.

Relieving has grown up with baseball. In 1904 J. W. Taylor of the National League went a fantastic 352 innings without relief. In the American League W. H. Dinneen went 337 innings—enough to



Save My Game

cover 37 complete games! Name a reliever from 1904. If you can, you're one up.

During the next 35 years an occasional club had an outstanding stopper. "Grandma" Johnny Murphy of the New York Yankees was one. When someone asked Lefty Gomez the secret of his success, he answered without hesitating, "Clean living, a fast outfield and Johnny Murphy." He swore he'd continue pitching "as long as Murphy's arm holds up."

But before World War II nobody paid much attention to what went on in the bullpen of most major league clubs. Old-timers and an assortment of "promising" or erratic pitchers held down the benches. A trip to the bullpen often meant a one-way ticket—down. But when I reached the American League three years ago, all of that had changed.

The first inkling that something big was happening came with the acute manpower shortage due to the draft. Clubs began to look for men the draft didn't want.

The experiment had a price tag attached: somebody would have to back these pitchers up *regularly*. That somebody was the "fireman." Those days of spare talent uncovered an impressive fact.

A man could actually pitch in nearly half his team's games without dying of total exhaustion.

By the time the 1947 World Series between the Yankees and Dodgers rolled around, relieving made its big jump to respectability by the performance of Joe Page and Hugh Casey in seven wild games.

Firemen took over. Page pitched in four games for New York, and Casey worked in a phenomenal six for Brooklyn! The '47 Series was called "The World Series of Relief Pitching," and that was the start.

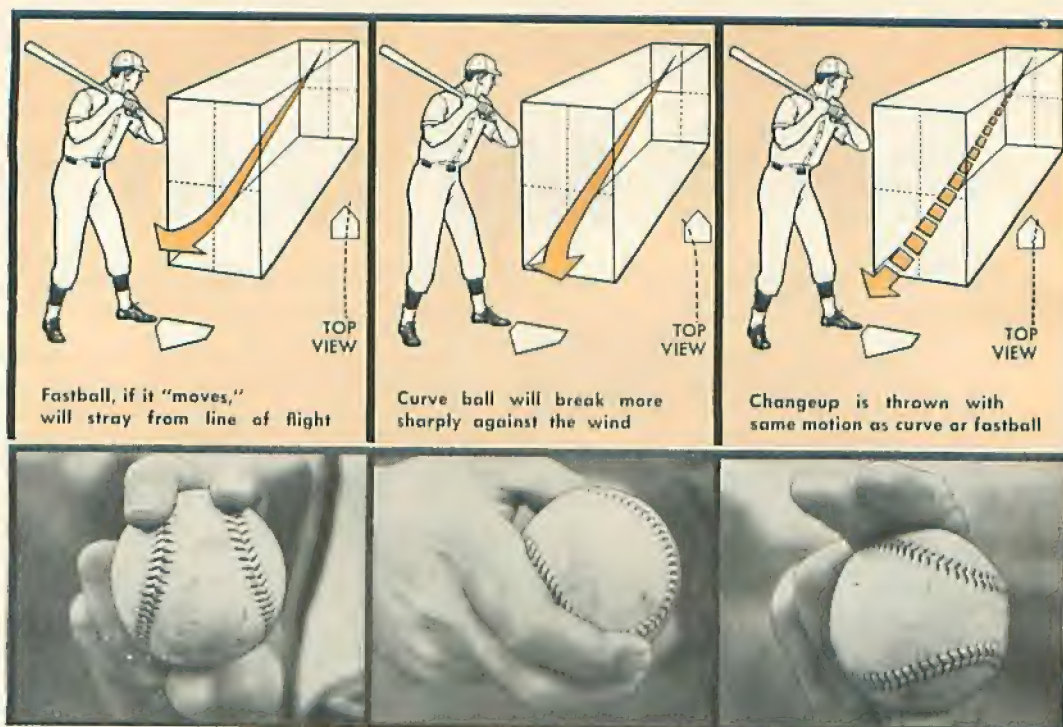
Is relief pitching really a "specialty"? You bet it is—and a very necessary one. When I started relieving for the Red Sox, I was skeptical, but hustling out to the mound in the late innings has taught me that my job is as necessary a specialty as a defensive halfback in football.

Baltimore's top-notch fireman, Stu Miller, recently spelled it out. "There has been in the last few years a trend toward the specialized relief pitcher. With the much better equipment, it is becoming increasingly difficult for starters to finish games. Therefore a good relief pitcher is almost a must on a contending club."

Let's see how my job differs from the



THE MONSTER, Dick Radatz, demonstrates form that blows down batters in late innings and gives him remarkable earned-run average of about 2 runs per 9 innings—all in relief. Standing 6-foot-6 and weighing 250 pounds, Radatz throws fastball with sidearm motion that looks to batter like ball is coming from somewhere near third base



STANDARD PITCHES include fastball, curve and changeup. Fastball and curve are held on or across seams, but fastball rolls off both fingertips and curve over forefinger. Slower changeup can be gripped by second joints

job of a starting pitcher.

Since I often take the mound in the middle of a jam I can't possibly pace myself. Pacing, or stretching out his energies for a nine-inning stint, allows the starter to relax a bit when the pressure is off. On the other hand, a first-flight reliever like Hal Woodeshick of the Colts declares, "I always pitch the same in a ball game—I always bear down!" He's right—and it can be maddening.

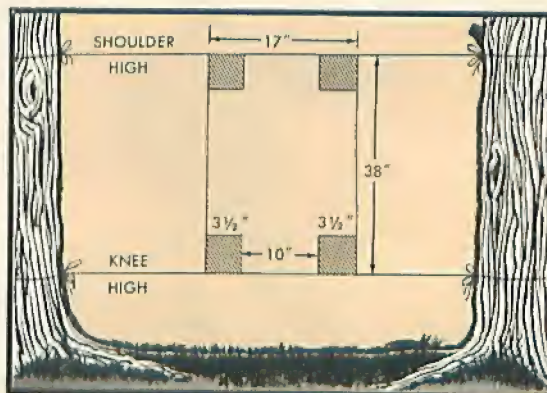
Late in '62 we were playing the Yanks in Yankee Stadium. In the 8th inning I got the nod, waved the bullpen boys farewell and plodded to the mound. Obviously the game was too far along for a pitcher to think of pacing himself, so I gave it all I had, mixing up my fastballs and sliders. When we finally won 3-2, I was still bearing down on every pitch, not daring to relax—nine innings later!

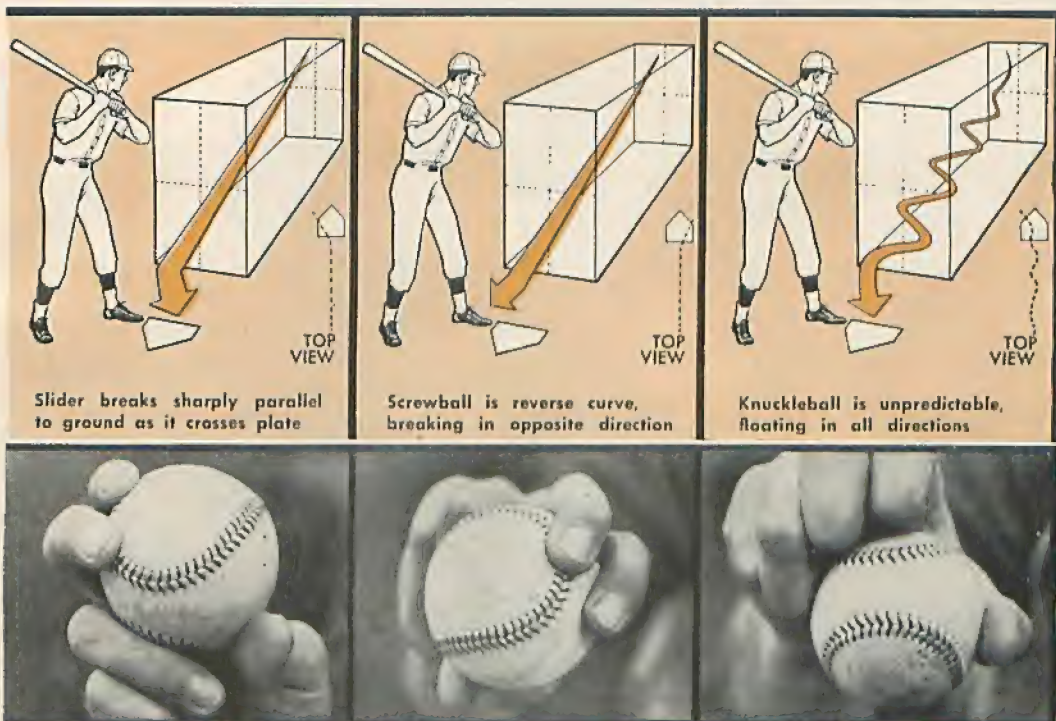
Next to bearing down, A-1 control is another must for relievers. Usually when my manager, Johnny Pesky, sends me in, men are on base and the game is close. These two factors generally demand that I give up no walks. My speed—75 percent of my pitches are fastballs approaching 100

m.p.h.—means nothing if I can't get the ball across. My orders are deceptively simple: strike 'em out if you can, make 'em hit on the ground if you can't, but don't give up that base on balls.

Let's see how that fastball formula mix works in an actual game. Early in '63 we met the Yankees in Yankee Stadium, in another game important to us because

BACK-YARD RIG can help young pitchers. Ropes between trees outline standard strike zone. Upper and lower corners show where pros aim most pitches





Slider breaks sharply parallel to ground as it crosses plate

Screwball is reverse curve, breaking in opposite direction

Knuckleball is unpredictable, floating in all directions

PET PITCHES include slider, held off-center and thrown with spiralling motion; screwball, thrown with reverse snap and rolled off middle finger; and knuckleball, held with fingernails or knuckles and floated up to plate

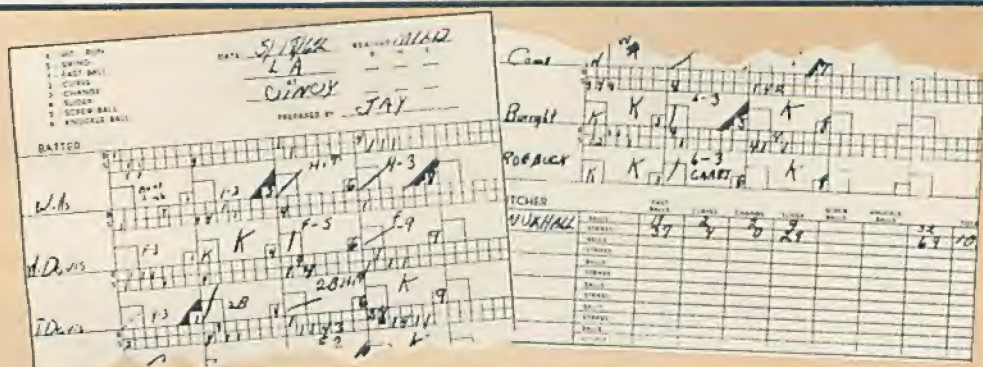
we were trying to hang on to second place. The Yanks are always tough, but we stayed with them into the eighth inning. Then, with the score knotted at three-all, Tony Kubek got to third with none away, and Pesky waded me into the game.

The first man I faced was Tom Tresh, and the guessing game between us began. Lesson one for every pitcher is the im-

portance of getting the first pitch across the plate. Odds are against the batter going for the first pitch, so I blew a fast one by him for strike one. That was a gamble, of course, because Tresh is definitely a fastball hitter, who has fattened his average on fastball pitchers. Remember, he hit a Sandy Koufax fastball

(Please turn to page 202)

PITCHER'S CHART of actual game between Cincinnati and Los Angeles records detail of types of pitches whether balls or strikes and what batter did with each. Charts can show weaknesses of certain batters against certain pitches and can help both starting and relief pitchers outguess batters during game





..Our New

It can stand on its bow, sit on its stern, spin like a top and tie up at ocean bottom depots or re-supply from other subs

By William Kreh

SECRET of new sub, embodied in Cdr. Haselton's 18-foot model (left), is hull-girdling propellers, enabling ship to perform hydrobatics like a helicopter

FLEET SUBS in the new configuration may deposit missiles in sea-bottom depot through bow or stern hatches; remotely guided TV camera in vessel with same propulsion system can be launched from missile hatch, as shown, and be retrieved

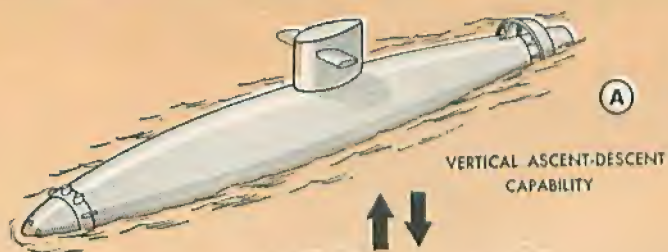
Windmill Submarine

DURING THE PAST few months, Navy experts lining the sides of test tanks have watched an 18-foot model of a wild-looking submarine perform tricks no sub has ever played before.

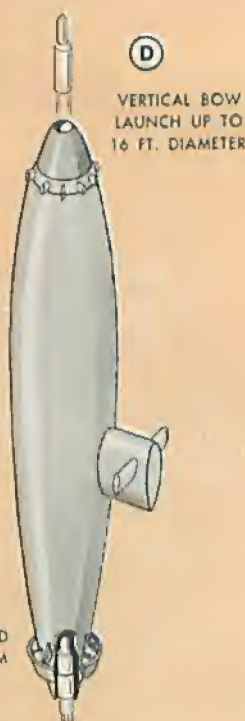
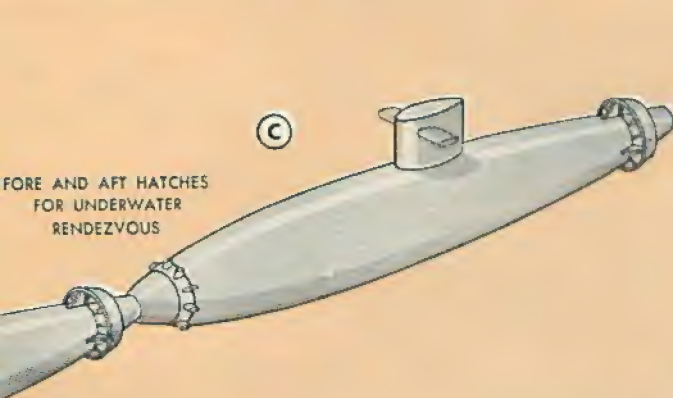
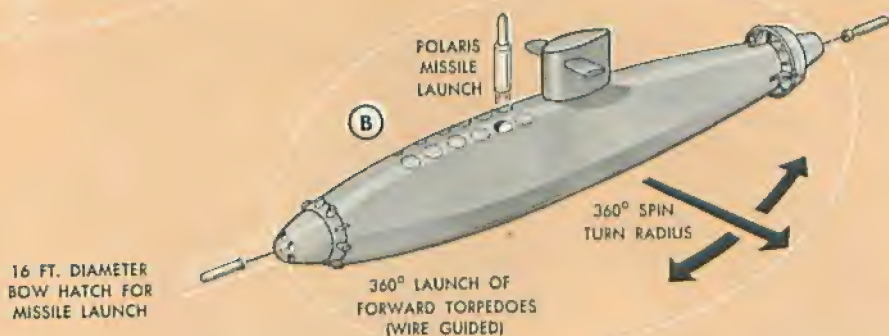
The sleek, cigar-shaped hull, sporting a ring of whirling blades fore and aft, levitated itself like a helicopter from tank bottom to surface. Then,

without budging forward or backward a single inch, it went to the bottom again like an elevator. It "hovered" at mid-depth, spun on its center in 360° turns. It crabbed sideways, first in one direction, then the other, and indulged in a mad assortment of hydrobatics—such as rolling over, standing on its bow and then on its tail. It also sped around the tank in normal attitude,





360° AFT TORPEDO CAPABILITY
ALLOWS WIRE
GUIDANCE UNDER WAY



VERTICAL DIVING
MANEUVERABILITY

MISSILE IS DEPOSITED
ON OCEAN BOTTOM
THROUGH 16 FT.
STERN HATCH

UNLIMITED undersea acrobatics can be performed by new sub by controlling blade pitch on counter-rotating tandem propeller rings. Presenting flat blade on downswing, sub rises vertically. Reverse pitch and it descends (A). With front blades pulling one way, rear the other, she swings on her own center (B). She'll stand on her end (D), or connect end-to-end with another sub beneath waves

with the agility of a scared rabbit.

The implications of this performance are vast. The giant model may well be the forerunner of a brand new fleet-type sub that will revolutionize submarine warfare techniques.

The vessel will have no rudders or diving planes, yet will dive deeper than ever thought possible. It will be able to stand upright and "plant" missiles on the ocean floor and later inspect and service them. Or it could assume the same position to fire a Polaris missile out of its bow. It will be capable of rendezvousing and connecting underwater with another submarine for rescue work or to exchange crews. It will be able to fire torpedoes from its stern while revolving around its own dead center, giving it a 360-degree range. And its ability to maneuver freely at great depths will open up new vistas in the science of oceanography.

All this will be possible by using a unique new method of propulsion that is now being studied and developed by the Navy. It's called tandem-propeller propulsion and it uses an "inside-out" electric motor completely submerged in sea water.

This submarine of the future will be propelled by two rings around its hull, one near the bow and the other near the stern. Each ring has 18 to 20 blades projecting from it. Each blade, about 2½ feet long, has independent variable pitch.

The hula-hoop-like rings encircling the submarine run in opposite directions. Various combinations of rotation speed and propeller pitch move the craft in any direction, or at any angle, through the water.

Inventor of the new propulsion system is Commander F. R. "Ted" Haselton, USN, a Naval Academy graduate and veteran submarine officer. In his office at the Un-

dersea Warfare Branch of the Office of Naval Research in Washington, D. C., Haselton showed *Popular Mechanics* the first working model of a submarine using his idea. Most of it was built in his own basement workshop a few years ago.

About 25 inches long, the model was operated by the commander in a tropical fish aquarium and was used to convince the Navy that the tandem propeller idea was worth investigating. For a while, his fellow officers referred to Haselton's office as the "Rotor-Rooter Branch." They don't any more.

Today, the Navy is testing an 18-foot all-aluminum model at the David Taylor Model Basin in Carderock, Md. If this craft, designed both for remote control and for driving by a scuba-equipped operator in a cockpit, proves out, a 25-foot television-guided version now on the drawing boards will be constructed for further tests. After that comes a full-sized operational submarine.

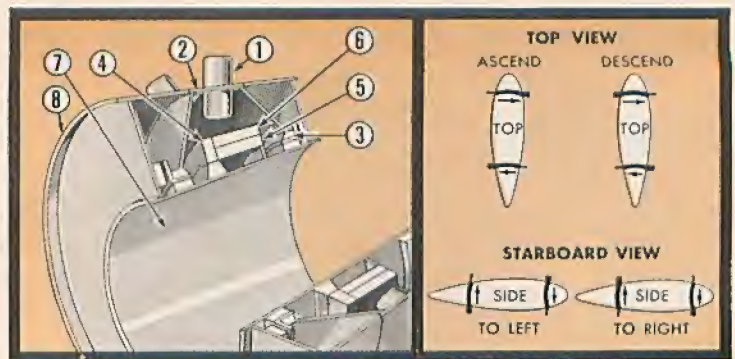
Just how does such a submarine work?

"Moving a tandem propeller submarine forward and backward is done the same way as by conventional propellers," Haselton explains. The difference is that my props turn in opposite directions; the torque produced by one offsets the other.

"To go up or down," he continues, "the pitch of each blade is varied during each revolution so that on the downward half of the propeller's cycle, the pitch of the blades is greater than it is on the upward portion. Thus, if the forward unit is rotating clockwise, its blades will have greater pitch while traveling down the right-hand side of the vehicle than they do going up the left side. Therefore, they will produce a force which moves the submarine

(Please turn to page 208)

ROTOR motor for full-scale sub in cutaway at right shows: 1. individually controlled blade; 2. rotating ring; 3. friction bearings; 4. transformer; 5. A.C. field; 6. rotating armature; 7. pressure hull; 8. superstructure hull. How blade control maneuvers sub is shown at the far right





High Water Skiing on a Hybrid Board

High-altitude water skiing can be done on the Surf-N-Ski by those who like something different to do. The rider begins by planing on the board as the towing

boat gets under way. As speed increases, the ski moves up, lifting the board and rider. Height adjusts from 10 inches to four feet. Maker is Chips Co., Gurnee, Ill.



Deck for Sedan

Like the fold-down seat of a station wagon, a new rear seat for a Ford sedan converts to a flat deck.

Requiring no special parts, the new seat can be installed with access to the trunk or with a solid bulkhead.

It's currently available on special order for the Ford Custom, Custom 500 and Galaxie 500 series, in two or four-door models. Retail price is \$81.40.



New Angle for Curves

When an experimental car built at the University of Illinois turns a corner, all four wheels tilt into the curve like two motorcycles traveling side by side.

Charleton Jones, the engineering student who built the car, found that the wheel action increases force on the tires and reduces slide in the turns. He feels it's particularly adaptable to racing cars.

Cabin in the Sky

Conversion takes only five minutes with this detachable, folding two-man sleeper unit. It's all plywood and weighs 150 pounds. Panels are hinged together. A screen on either side provides ventilation. Clamps hold the home-built unit in place. It was made by Carl Stude, Burbank, Cal.

Kids Blast Off in Playground

The trip is a short one in this 26-foot "moon rocket." The craft is held erect by its four steel fins and a center pole. An escape hatch in the second stage lets crewmen slide quickly to the ground, which is padded for safety with redwood bark. The rocket was installed in a Phoenix, Ariz., housing development by Hallcraft Builders.



Cooks Food or Warms Campers

A portable infrared stove takes up to a nine-inch cooking pan and is adjustable for use as a heater. Flameless, it converts propane gas into radiant heat. Said not to leave carbon deposits on pans, it operates four to six hours on a 14-ounce gas cylinder. Price: \$24.95; Paulin Infra-Red Prods., 2536 St. Clair Ave., Cleveland, Ohio.



Toothsome Barracuda



TRACES of the 1964 Valiant are apparent in the front and rear fenders of the Barracuda, above. Rear seat back folds down, right, a la station wagon to form an extra interior luggage compartment



BARRACUDA has what Plymouth claims is world's largest rear window. Certainly it is the sweepiest fastback this side of an Italian custom. Beneath window is a locker for spare tire plus luggage

THE YEAR 1964 will be remembered by those who love sporty, exotic and exciting automobiles as the year in which the dream cars came to life.

Plymouth kicks off the trend with its Barracuda. This is not a one-of-a-kind to be ogled at behind velvet ropes, but a car that anyone can buy this month.

Although known as the *Plymouth Barracuda* the new car is based on the 106-inch wheelbase Valiant unit body and chassis. It offers buyers a choice of Valiant's 273-cubic-inch V8, 225- or 170-cubic-inch slant Six engines, any of which may be teamed with three-speed manual,

automatic, or four-speed synchromesh transmissions.

The Barracuda will certainly capture the award of "fastback of the year" with its sweeping, swooping roofline extending from the windshield header to just a few inches from the rear bumper. The greatest part of the sloping back is a giant rear window (or is it a glass roof?) of 2077 square inches. Plymouth claims that it is the largest ever to be installed in a car.

The long sloping tail has eliminated the conventional parcel shelf and much of the trunk. Instead the rear seat folds forward to give access to a large, carpeted storage area.

Add-On Bifocals

Bifocals that are an add-on attachment to regular eyeglasses can be carried in a purse or pocket until needed for close viewing. They're made of unbreakable plastic and sell for \$4.

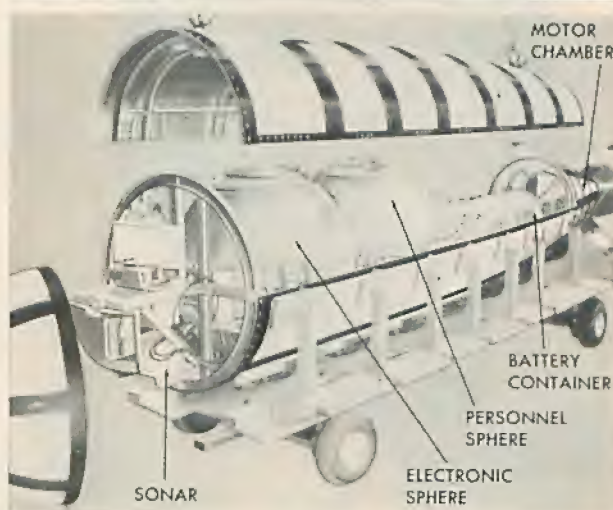
Designers are Robert H. Magnuson, M.D., and Arthur R. Magnuson, 150 E. Broad St., Columbus, Ohio.

Underwater Airplane

Carrying its two-man crew in a water-tight sphere, a new Navy submersible is designed to "fly" under water with the maneuverability of a plane.

The main hull is fiberglass. Water enters it during a dive; buoyancy is controlled by a buoyancy chamber and ballast.

An electric motor drives the 33-foot craft at a speed of 15 knots. The vessel was built at China Lake, Calif., Naval Ordnance Test Station.



Three-Keeled Sloop Draws Only 20 Inches

Drawing just 20 inches of water, a new fiberglass sailboat has more than its share of keels—one 250-pound center keel and two 50-pound bilge keels located slightly aft. It carries 163 square feet of sail and is designed for convenient single-handed sailing. Made in Denmark, the 18-foot Shark Cruiser is priced at \$2950 f.o.b. East Coast port of entry. It's imported by Shark Boats, Camden, Me.



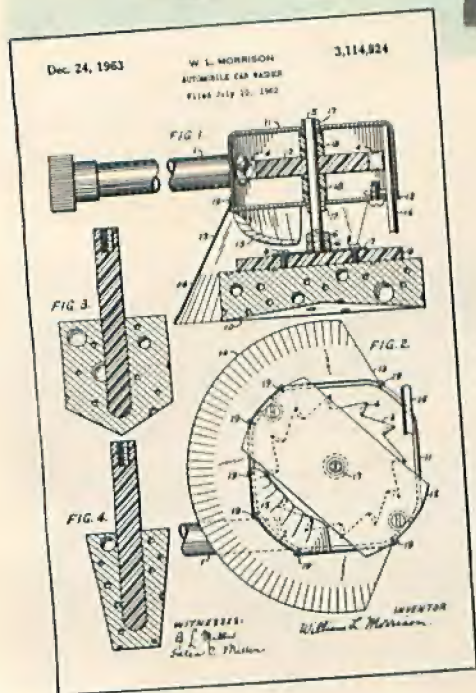
You Can Obtain Your Own Patent ... I Did

In developing and patenting my invention, a laundry tub was my research lab, and a shelf of the public library served as patent consultant

By William L. Morrison



AUTHOR with five of 15 models of his washer; final version is in foreground. His patent drawing is at left, below



IT WAS A SUMMER DAY BACK in 1961 that marked a change in my life, although I didn't know it at the time.

That day I was fooling around in the back yard, trying to make a decorative water fountain. After drilling a small hole in a pipe cap, I connected the pipe to the garden hose. Although the fountain worked, it wasn't a howling artistic success.

One thought struck me, though: The tiny jet of water coming through the orifice had surprising power.

For months, that simple observation must have washed around in my subconscious mind. When it suddenly gushed into my conscious thoughts, it was a full-blown idea for an invention.

Now, after two years of hard, sometimes frustrating work, I am the proud possessor of three sheets of paper which prove that I am an inventor. Regardless of the income from my invention (which promises to be



COMPLETE WASHER with all attachments; these are designed to wash inaccessible places, like crevices in the grillework and spaces inside the wheel rims



WATER JET powers turbine and provides fine rinsing spray across car surfaces, above right. A PM editor who tested the washer says "it washes up a storm"

SMALL SPONGE attachment reaches into taillight recess. Other attachments include a fine wire brush to rub rust spots off chrome and dirt off sidewalls



most profitable), those three sheets mean more to me than any paper I've ever owned—with the exception of my marriage certificate.

The paper makes me the owner of U.S. Patent No. 3,114,924. The patent cost me exactly \$66 for fees, and only \$50 in consultation fees for minimum advice from a former patent examiner. Without any experience, I obtained the patent myself.

Perhaps I should explain that I am not an inventor (at least I wasn't), and I have never had any legal training, in patent procedures or otherwise. I scarcely knew what a patent was until I made up my mind to obtain one—on my own.

By occupation I am a tire salesman. By marriage I have been endowed with the world's most patient and understanding wife (how she needed both those qualities!). Though I find it difficult to consider myself an inventor, I'm plunging ahead

with other inventions.

But I honestly believe that many men with no experience can come up with profitable inventions, and can patent them on their own *if they have enough determination.*

That was the key to my success. To prove the point, here's my story:

The question that popped into my mind from that crude water fountain was this: If low water pressure from a partially open sill cock can produce a jet of such force, why can't the latent energy stored in the full pressure of a city water system be used to power some kind of implement to wash my car?

Once that question took root, it wouldn't go away. At first I merely noodled around with the idea, trying to save myself the work of washing the car. But the more the noodles simmered, the more appetizing they became, and I soon was convinced

that such a labor-saving gadget would have excellent commercial possibilities.

In my first efforts to come up with something concrete, I used scrap materials that I found around the house. My first crude assembly included an electrical junction box, a short length of thin-wall conduit, a scrap of ordinary plastic and an old household sponge.

From the plastic I cut a small disk, then notched the rim, making a miniature water wheel that would become my water turbine. After drilling the turbine, I forced it onto a short brass shaft, then drilled the junction box and its cover plate to accommodate the shaft. One end of the shaft extended a couple of inches through the cover plate, and on it I installed a disk of hardboard to which I cemented the sponge. Then I soldered one end of the conduit to a hole in the junction box, and partially plugged the conduit so that only a tiny jet of water would emerge. On the other end of the conduit I rigged a connection to the garden hose.

In theory, of course, when I turned on the hose a jet of water would strike the "teeth" of the turbine and rotate it. The turbine, in turn, would turn the shaft, the shaft would whirl the sponge—and presto, the sponge would whisk the dirt and grime right off the car.

That was the theory. Actually, the sponge whirled all right, but stopped rotating as soon as I pushed it against the fender of the car. In addition water spewed

all over the place, including my clothing.

The experience dampened my enthusiasm but not my determination. The problems were obvious:

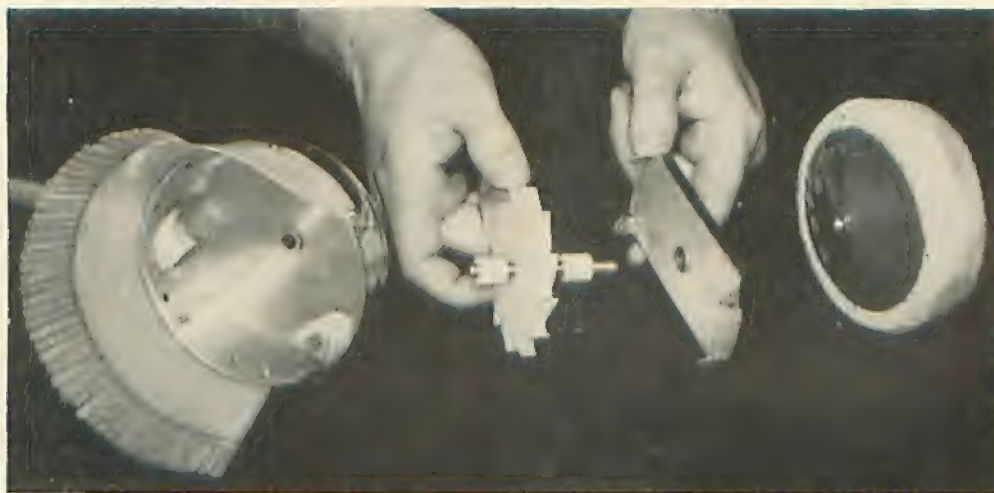
- The water jet did not produce sufficient power.
- The turbine was inefficient.
- The sponge provided too much drag.
- The spent water, after powering the turbine, had to be guided away from the operator and onto the surface to be washed.

In solving these problems, I built 14 different models of my car washer. It took five frustrating months. During that time I plunged down a good many blind alleys, only to return dripping wet. I'll capsulize all this work by describing the simple solutions (simple once they were known!) to each of the problems:

1. I increased the power of the water jet by doing some basic research—though my methods were unorthodox, to say the least. With no instruments at my disposal, I had no way of knowing the water pressure that would be produced by orifices of different sizes and shapes. It suddenly occurred to me that a postal scale could be used for this purpose. I bought one, placed it in the laundry tub, and directed jets of different characteristics against the scale's platform. In each case, I could read the force of the jet on the "postage required" bar. My resulting figures were all measured in postage stamps, but after a good many tests I came up with a genuinely heavy package to be mailed, and knew I

EXPLODED VIEW reveals the simplicity of the washer. From left to right are the housing with its attached skirt to prevent splashing; the small gear-shaped,

highly efficient water turbine; the cover plate, and the shaped sponge. Patent fees came to \$66, far less than the average patent applicant must pay



had solved the problem!

2. I increased the power of the turbine by altering its size and changing the shape of the notches or "teeth." My experience once again proved how a surprisingly simple observation can help an inventor. One evening I was rinsing the dishes for my wife when the water struck the bowl of a spoon. The water not only splattered over my shirt, but more important *it almost knocked the spoon from my grasp*. As a result, I tried hollowing out the "teeth" of the water turbine, forming, in effect little spoons or buckets. Considerable testing showed the optimum shape, which increased the power of the turbine tremendously.

3. In trying to solve the problem of high drag on the sponge, it occurred to me that the entire face of the sponge did not need to contact the surface *as long as the outer rim did*. I hollowed out the center area of a sponge, and found that this not only decreased the drag, but that the sponge actually did a better job of washing. Once again, I arrived at the optimum shape only after considerable testing.

4. Learning to control the water was perhaps the most time-consuming problem. I discovered that after the water powered the turbine, it tended to back up inside the housing, in effect clogging the car washer and cutting the turbine's power. Long trial and error produced a simple solution. A small metal channel, soldered into the housing at precisely the right

point, guided out the spent water and directed it against the car surface where it would do the most good. However, this did not completely overcome the problem of some of the water splashing the operator. I eventually solved this with a semi-circular plastic skirt—a protective shield—slit along the bottom so it would conform to the configuration of any surface.

My final model, incorporating all these solutions, works far beyond my expectations. It has amazing scrubbing power, is simple to use, and will completely wash the average car in eight minutes without the aid of any detergents and with considerable savings in water. I have also developed simple attachments for the car washer. These include a small pointed sponge to reach into wheel rims; a fiber brush to reach into the crevices of grillework, and a fine wire brush to abrade rust spots off the chrome trim.

When I was convinced my car washer would work better than anything on the market, I made up my mind to secure a patent myself. The first thing I learned was that study pays.

My first step was to go to the Chicago Public Library and consult the files of the *Patent Office Gazette*. This is an official publication of the Patent Office, and contains capsule summaries of all recent patents. It also tells how to look up patents by classification and subclassification.

I found the classification that applied to

(Please turn to page 188)

POSTAL SCALE was used to ascertain water pressures. Indentations on plastic were sprayed with jets of water to determine best shape for turbine "buckets"



WASHER ITSELF was used as a lathe to shape sponge-rubber attachments in family laundry tub. Cylindrical shapes were difficult to cut from sponge blocks



Fly-in resorts are the latest luxury in aviation, opening up a new way of life for week-end pilots who just want to fly away from it all



Country-Club Airports

AIRLINE SEATS are standard equipment in lounge of Flying W, typical of all-out trend to appeal to pilots and give them a fly-in place of their own



By Kevin V. Brown

"MOST PRIVATE AIRPORTS are merely parking lots. Some are no better than junkyards."

That's Bill Whitesell talking, but he's only half angry. The other half is promotion. Whitesell is creating one of the latest and most ambitious of the so-called country club airports—luxury landing fields where the average week-end pilot can fly his family and friends for a few hours, or a few days, of just plain fun.

It hasn't always been so, and still isn't in some areas. The average small airport enables the private pilot to land, take off and stow his plane. And some of them are pretty decrepit. The pilot has to get his kicks in the air. The new trend is to make airports into swanky fly-in resorts with facilities for the whole family or, conversely, to make resort areas that already exist more accessible to flyers.

Whitesell's *Flying W* is one of the best examples. It's a dude ranch for pilots in—of all places—New Jersey. It attracts a few laymen (the nearest town, a small one, is four miles away), but the bulk of its city-slicker visitors fly in from areas several states away. On a good week end, it has nearly 1000 takeoffs and landings.

When visitors arrive, a cowboy-clad greeter lays down a red carpet and invites them inside where, for an airport restaurant, unusually good steaks are served and a sign behind the bar reads, "Flying Spoken Here." Outside, in summer, they



WATCH FOR AIRCRAFT

OTIS LODGE is one of oldest resorts catering to flyers. Sixth hole on golf course crosses runway, so golfers are given unique warning. They fly in for fun, fly out again

FLYING W is newest country-club airport—a dude ranch for pilots. Swimming, riding, hiking, fishing are among attractions for visiting flyers and their families, even children



can swim in the airplane-shaped pool, ride horses through 150 acres laced with trails, play golf, hold picnics, fish in two miles of stream or, in season, hunt game.

Is this any way to run an airport? Lots of others think so. On the west coast, the *Palm Desert Airpark* near Palm Springs holds luaus, moonlight hayrides and chuck-wagon breakfasts to attract pilots—including movie stars—who love to mingle with their own kind and swap stories in pleasant surroundings just like other hobbyists.

Such surroundings are rare for them. While aviation has progressed, most private airports haven't grown past the leather helmet and goggle era. If a plane owner wanted to fly to a resort for a week end or vacation, he'd have to find a nearby airport to land on, then drive the rest of the way. The country-club airports now offer both in one.

The *Flying W* or the *Desert Airpark* are two of the more exotic country-club types, and a vacationer could easily spend a week or two at either without running out of things to do, though the *Flying W* is still

under development. The *Desert Airpark*, in its brochure for guests, lists one rule not found at the usual resort: Please keep children off the runways.

Earlier than either, however, is the *Otis Lodge* in the northwoods wilderness near Grand Rapids, Minn. It features both a large lake for fishing and swimming and a nine-hole golf course. The sixth hole, in fact, crosses the north-south runway and golfers are warned to watch for low-flying aircraft. The airport radio is in the kitchen where the chef can talk to incoming pilots while he broils a Northern walleye.

The *Sea and Sky Portel* on the dunes-like tip of Long Island, N.Y., has no golf course, catering instead to the water-minded types. It has a marina for boats and lots of sandy beach for ocean swimming, sunning and picknicking. There's also some pheasant shooting in the fall.

On the West Coast, a similar resort, *Skyline Marina*, is located on Fidalgo Island, Wash. Some vacationers just fly in, hop in a boat and go deep-sea fishing, eliminating ground transportation altogether.



SEA-SKY PORTEL attracts flying fishermen who alight from plane, climb into boat and go fishing off tip of Long Island



SIERRA SKY PARK is ultimate in aviation developments—residential area for flyers with landing strip as main street



AIRPLANE-SHAPED swimming pool is major feature of Flying W. Lighted at night, it often startles airline pilots who circle field wondering what it is

PILOT'S APPROACH to Flying W's paved runways is new experience for flyers—a resort built for them, without "junkyard" atmosphere of many airports



Among the specialized airport resorts, those catering to fishermen or skiers are the fastest growing. In most cases, the resort areas were already there, but the landing strips were put in to make them more convenient for pilots. One of the most aggressive, *Boyne Mountain Lodge* near Boyne Falls, Mich., reports up to 30 plane loads a day during peak ski seasons. Another area boasts you can fly in, park your plane, and schuss to the slopes.

Some state governments—notably Kentucky, Iowa and Idaho—are taking an active part in locating landing strips near remote fishing and hunting areas for flying outdoorsmen. Previously the only access to these game-rich areas was by cumbersome dirt roads and trails. Some strips are now within a few hundred feet of fishing streams.

Perhaps the most unusual concession to the air age, however, is *Sierra Sky Park*, which is not a resort at all, but a residential subdivision complete with shopping center, quiet streets—and landing strip. Under development near Fresno, Calif., it even has a corner service station for airplanes. Back from a hard day at the office, the pilot flies home, taxis up a side street and parks the plane in his driveway.

So aviation has come a long way for the private pilot from the days when he flew in open cockpits and landed in unmarked cow pastures. He's joined the country club set. What next? Fly-in movies? ★★★

Blinking Bobbies

Police in Derbyshire, England, are experimenting with a safety light that is worn on the helmets of bobbies making nighttime rounds.

Flashing at intervals, the blue signal is powered by a one-pound battery carried in a canvas bag strapped to the officer's belt. Visible for 300 yards, it may cut down police accidents.



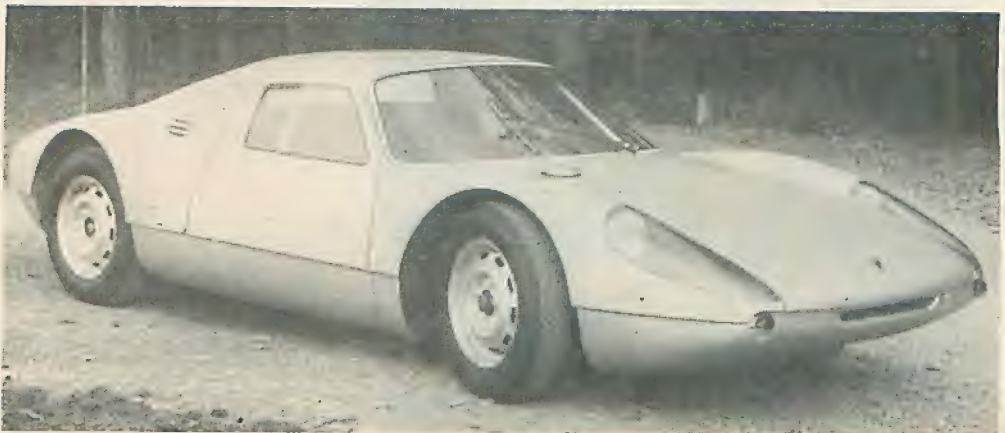
Lightweight Studio

The Newschief, combining TV camera and transmitter, weighs just 25 pounds. The system, developed by Sylvania, was used by the American Broadcasting Company to cover the Winter Olympics at Innsbruck, Austria. The camera measures a scant 3 by 4 by 8 inches and delivers pictures as good as those from a TV studio. A rechargeable nickel cadmium battery supplies power for an hour.

Porsche 904: Body of Fiberglas and Speed of 160-Plus

Porsche's new Type 904 houses the over-head-cam Carrera air-cooled engine in a sleek, needle-nosed fiberglas body—all only 3½ feet high, 161 inches long, and 330 pounds lighter than its predecessor. By the conservative DIN method, the pancake

Carrera's rating is 180 hp. at 7000 r.p.m. At 5000 r.p.m., torque peaks at 148 lb.ft. The engine is mounted ahead of the rear axle. Factory information indicates a top speed above 160 miles an hour. In Germany it costs the equivalent of \$7425.



New for Your Home



TWIN COOKER GRILL has 14 by 18-inch cooking surface. Closed, it's a smoker; half-open, the top acts as windbreaker. Stainless steel unit costs \$24.95 from Sipe Enterprises, Box 2004, Daytona Beach, Fla.



SAUNA HEATER features through-the-wall mounting for Finnish-style bath. Automatic, it heats stones to make steam. Built-in air circulator, thermostat and controls operate on 240-volt house current. Unit by General Electric is under \$650.

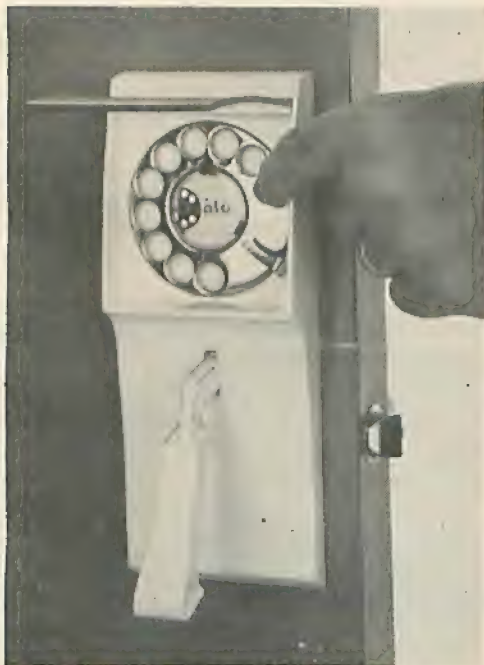
SWEEP-CLEAN frame and removable container of steel fits between floor joists in kitchen or family room, holds up to three weeks of sweepings. \$9.95 unit is 12 by 3 by 6 inches deep. Ultram, Bloomington, Minn.



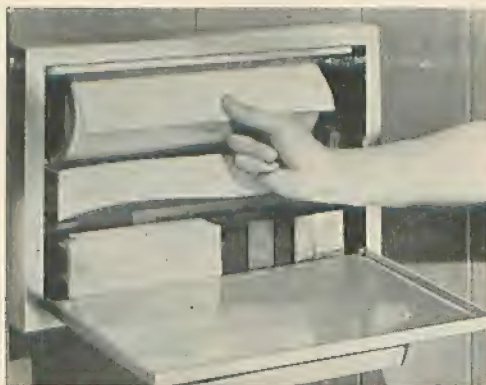
SHOWER AND TUB VALVE diverts water by pushbutton; knob preselects temperature and volume. A sealed cartridge controls operation. Price: \$20.75. By Moen Faucet, Div. Standard Screw Co., 377 Woodland, Elyria, Ohio.

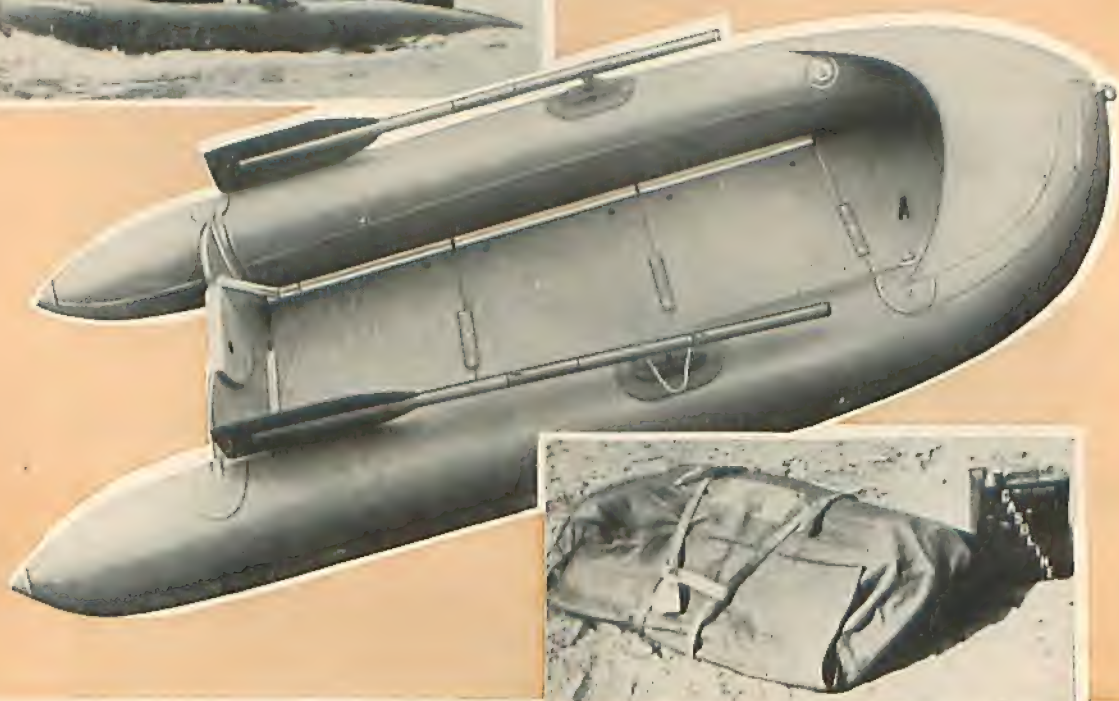


DOOR LOCK operates like telephone; dial sequence of four numbers, lift latch and door opens. Press handle, door locks. \$29.95; by Dialoc Corp. of Amer., 3120 46th Ave., N., St. Petersburg, Florida.



KITCHEN CADDY hides away seven dispenser cartons and large towel roll. 11-by-16-inch item installs in wall. \$18.75 from Swanson Mfg. Co., Owosso, Mich.





Inflatable Boat Has Wood Floor and Transom

Made of neoprene-coated nylon, a new inflatable boat provides stable footing with a full wall-to-wall sectional floor of marine plywood. For safety, it has three separate air chambers—two torpedo-shaped pon-

toons and an inflatable keel. The Speedyak will take any outboard up to 7½ hp. and is priced at \$199.50 f.o.b. Kayak Corp. of America, Inc., 133 W. 45th St., New York 36, N.Y. It folds flat for storage.

Built-in Bowsight

Archers can now obtain a bow with a sight that's an integral part of the bow. The sight adjusts easily and precisely to wind, elevation, type of arrow and style of shooting. Manufacturer is Bear Archery Co., Grayling, Mich.



Back-Country One-Lunger

The four-wheel-drive Arctic-Cat 1000 is powered by an air-cooled, 10-hp. gasoline engine through torque converter and forward-reverse gears at speeds to 12 m.p.h. Price: \$1875; Arctic Enterprises, Thief River Falls, Minn.





Stop! Schoolboy Crossing

After the boy was injured by an auto, Philippe Aldiere's grandfather rigged his schoolbag with a red light operated by a button on the handle. Now when he crosses streets in Paris, Philippe can bring the cars to a halt with the red light and make his way to school safely.

Boat Bailer Runs Like Clock

Harnessing the pendulum motion of a suspended weight to run the pump, a new automatic boat bailer is powered by the gentle rocking of the boat. Bail-O-Matic sells for \$39.95 from E & R Lab. Service Corp., 7413 Florissant Ave., St. Louis, Mo.

Sightless Shooting

Blind war veterans at St. Dunstan's Hospital near Brighton, England, are able to enjoy indoor target shooting—often scoring 70 out of 100. They sight through an electromagnet that causes their headphones to receive notes of varying pitch until sights align with the bull's-eye.



Remote Mower

A mower designed to fit any tractor cuts difficult spots along ditches, across fences and on steep slopes. The 1800-pound Slopemower's telescoping boom has a 28-foot reach; its rotary blade cuts a swath of weeds 60 inches wide. Astron Corp., 5321 Rice Ave., Houston 36, Tex.



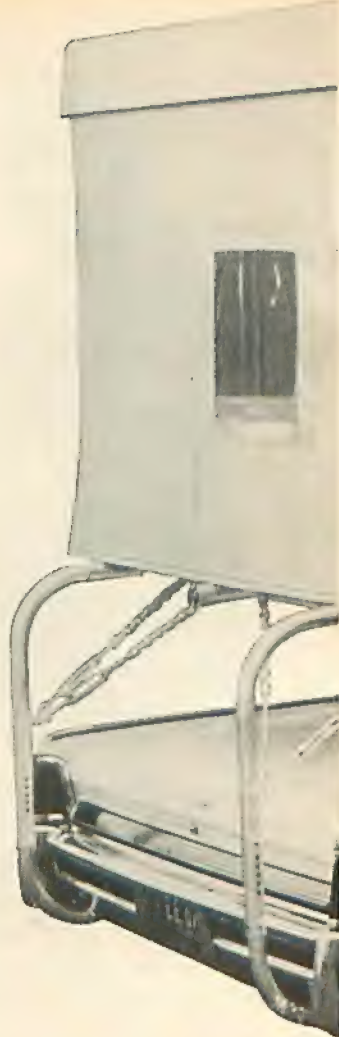
Modern Gypsy Caravans

THE MOST REVOLUTIONARY TREND in modern camping equipment has been the evolution of the tent from a cumbersome, hard-to-assemble pile of canvas to a compact two-wheel trailer that blossoms into a spacious sleeping-and-living unit with the ease of unpacking a large suitcase.

Basically, the camper-trailer unfolds into a tent on wheels, with the traveling top converting to two foam-cushioned beds. They range in price from \$200 for a kit you assemble yourself, to \$900 for a deluxe aluminum-bodied model with two twin beds, built-in stove and storage units, dining table, and a large canvas room extending from the basic unit.

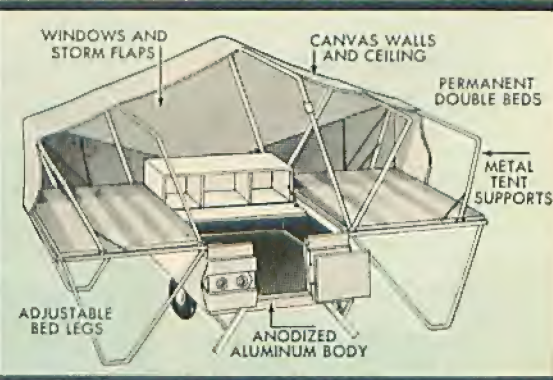
While the basic tent trailer does not offer all the comforts of home, it does make setting up camp only a ten minute chore. And most campers also incorporate built-in storage space for food and equipment, eliminating the need for packing and unpacking when the family moves to a new location.

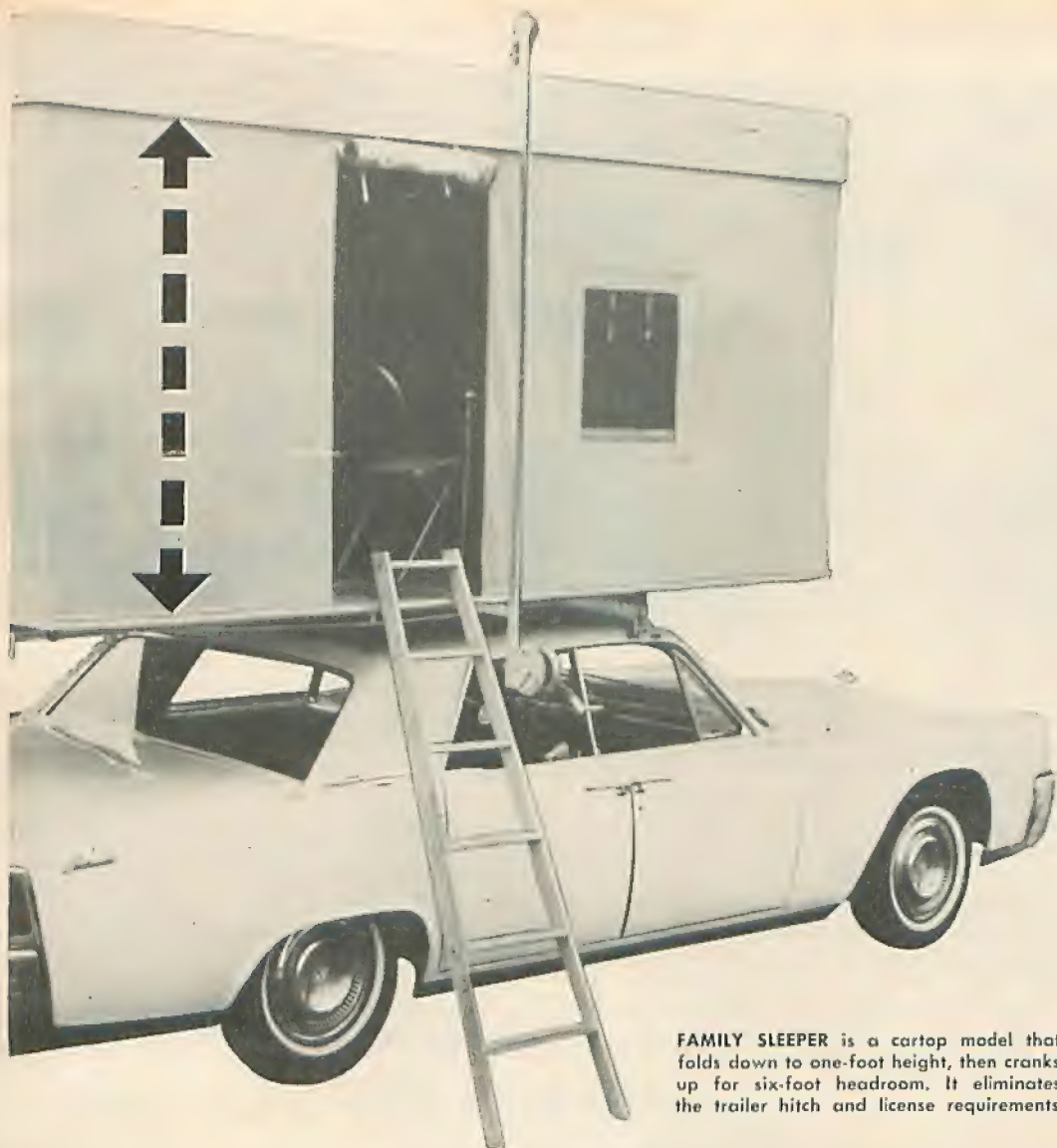
Branching off from the tent trailer is a wide variety of unusual designs to serve the same purpose. The Family Sleeper, made by Equal-i-zer Co., Salt Lake City, Utah, offers a cartop sleeper that is only one foot high for traveling, but expands into a canvas room 12 feet long, 6½ feet wide and 6 feet high. It sells for \$545. Holsclaw Bros., Evansville, Ind., has a small utility work trailer, 44 inches long, that can be



UNFOLDING ELECTRICALLY, the Rolite opens into an aluminum house trailer. It sleeps four and offers the added comforts of running water and a gas range

BASIC DESIGN for tent campers is shown in this cutaway drawing of the Apache. Compact for traveling, it unfolds into a spacious canvas sleeping area





FAMILY SLEEPER is a cartop model that folds down to one-foot height, then cranks up for six-foot headroom. It eliminates the trailer hitch and license requirements

PICKUP TRUCK converts to camper with folding unit that sleeps two. Work-N-Play Top is easily removed when truck goes back into service for work

CONESTOGA WAGON design is called Canvasback. The steel hoops are removed for traveling, and easily snap into position. It will sleep family of six





MOTELMOBILE is luxurious seven-sq.-ft. room. It sleeps two on foam-rubber bunks that serve as couches, and offers shower, dining table and propane cooking range

CANVAS TOP is optional equipment to turn the Holsclaw utility trailer into an overnight sleeper. Its main features are its light weight and a moderate price.



converted to a sleeper with a canvas top that utilizes the extra length of the tailgate. The complete unit sells for \$288. Independent Products, Goshen, Ind., sells a folding canvas camper adapted to a regular pickup truck that a woman can raise and lower. It sleeps two on foam-rubber bunks, and has 213 cubic feet of living space. The Siesta II, made by Walter Products, Owosso, Mich., looks like a conventional house trailer, but a canvas extension adds 130 square feet of living area. It sells for about \$1000. The Mallard Coach Corp., West Bend, Wis., offers a camper

that looks exactly like a Conestoga wagon.

Getting away from canvas altogether, Rolite Inc., Grantsburg, Wis., has an aluminum house trailer that folds up electrically to a traveling height of 50 inches. And in the same vein, Regal Associates of New York City, is distributing the Motelmobile, an aluminum and plywood camper that is hand-cranked from 48-inch traveling size to a plush room seven feet square. For this added luxury you'll pay \$1495.

The innovations seem endless, but they point up one fact: when Americans turn gypsy, they go in comfort.—*Stuart James*

VAST LIVING AREA, including insect-free mesh sitting room, is appealing feature of Siesta II. Folded for traveling, it is only 13½ feet long





Double Cot for Campers

If the traditional single cot is too narrow for campers used to a double bed, there is now a wide cot to accommodate them. The 13-pound "Duo Cot" is four feet wide, six feet, six inches long and easily portable. It retails for \$37.50; Goode Products Co., 7542 Maie Ave., Los Angeles, Calif.



Underwater Loudspeaker

With a microphone in a mouth mask, underwater communication can take place without special hearing aids. "Watercom" uses a battery powered transmitter to amplify the voice directly through the water, permitting audibility within 100 yards. The Bendix Corporation offers the unit, complete with battery, for \$252.



Two-Cycle Cookery

Next time you're packing a cold lunch to take along in the boat, toss in a can of beans or chili. Then, half an hour or so before you want to eat, put the can in a landing net rigged to hang in front of the outlet of your outboard's cooling system. Result? A hot dish which turns that cold lunch into a satisfying meal.

SNUG CAMPING IN FOUL WEATHER



Starting fires with wet wood, turning a stove into a radiant heater, drying soaked boots in half an hour, the experienced camper adapts to nature's quirks

By Pat Snook

BAD WEATHER doesn't have to dampen the fun on your camping trip.

While some campers shudder at the sight of a dark cloud and run for home or the nearest motel, the experienced outdoorsman merely adjusts to the prevailing weather and comfortably continues with his outing.

Camping's biggest and most basic attraction is its challenge. With just a few improvisations you can adapt to any weather, adding enjoyment to your trip, whether you pitch your tent in the wilderness or the largest commercial campground.

Awakening in the morning to the sound of rain on a tent roof is a wonderful experience—until you remember you have to start a fire and you forgot to stow a supply of dry wood for just such an occasion. If you have some candles—it's a good idea to carry a supply of old stubs—place one in the middle of a "teepee" of small wet

twigs. By the time the candle burns down the stack of twigs will have dried enough to catch fire.

If the rain is really coming down and you need protection for your fire, look for a good-sized rotten birch tree that has fallen. The pulpy inside is easily removed, leaving a bark cylinder. Build your small fire inside a section of the bark. The kindling will be protected from the rain, and once it gets started the birchbark will burn through and make secondary tinder for the larger fire. Finding dry wood for that larger fire might seem impossible, but there's plenty in a dead (but not rotten) tree that is still standing. What you want is one that gives a solid ring, not a dull thud, when you hit it with your axe. Fell the tree, cut it into fire-length sections. Split away the outside and you will find dry wood inside.

More excellent sources of fire-starting



WET AND MUDDY BOOTS will make a mess of a tent floor, but campers can easily avoid this by slipping plastic bags over the boots when they come inside



DRY DAMP CLOTHING after a rain by stuffing leafy branches in arms (or legs) of garments, button around a large branch of leaves and hang up in a tree

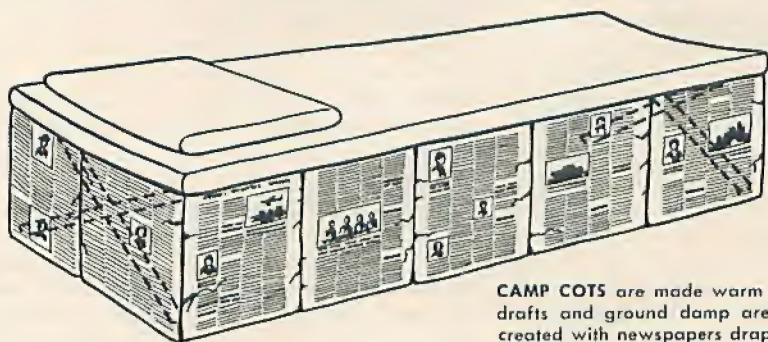
material in any weather are scrub pine and spruce trees. Near the bottom branches, you will find clusters of small dead twigs close to the trunk. The protection of higher branches keeps these twigs dry, and they are loaded with pitch, which makes them burn hot enough to get even the most difficult fire going.

Wet feet can take the pleasure out of any camping trip if you have sustained rain. If the soggy ground is getting the best of your boots, try using lightweight plastic bags as boot liners. Put the bags over not under your socks. There will be a problem of moisture condensation, because these bags do not "breathe," but you can solve this with heavy wool socks that are changed often.

Tracking mud into the tent can be eliminated by wearing the plastic bags over your boots, tied at the ankle with a piece



RADIANT HEAT can be reflected into a tent during a cold spell by burning a small stove before a sheet of aluminum foil draped over an A-frame of sticks



CAMP COTS are made warm and comfortable when drafts and ground damp are blocked by air space created with newspapers draped over sides and ends



DEAD MAN'S ANCHOR will hold tent guy lines in sand or soft ground. Two sticks are lashed into a cross, guy line attached—and buried in a shallow hole



WHEN AVAILABLE KINDLING is wet, a fire can be started with the small dead twigs always found growing low and close to trunks of pine and spruce

of string. When you leave the tent you remove the bags; put them on again when you return.

Drying out a pair of wet boots can take a full day in the sun or next to the fire. You can cut this time to a half hour by heating a skillet of sand or gravel and pouring it into the boot. Heat a second batch while the first is absorbing moisture and keep repeating the process.

An ordinary baseball cap should be part of your emergency gear. Worn under the hood of your rain jacket, the bill keeps the rain out of your eyes.

A leaky tent can produce more angry snarls than a bag of wildeats. Carry along a small block of beeswax or paraffin, and if you spring a leak, soften the wax by holding it between your palms for a few minutes, then rub it into the leaking seam, exerting just enough pressure to get it into the fabric. If this doesn't stop the leak, you can divert it to a less troublesome place by running your finger against the fabric from the leak to another spot.

During a siege of wet weather, don't make the mistake of buttoning up your tent too tight. Allow for as much ventilation as possible. If you kill the air circulation the resulting condensation will form droplets on the inside of the tent, and before long everything will be damp and clammy. This also holds true in cold weather, particularly if the tent is heated.

The necessity for proper drainage is one of those things that is taken for granted,

and no one seems to bother with. It is discouraging for a camper to wake up in the middle of the night and learn that he pitched his tent in a dry creek bed that has blossomed into a gurgling brook. This grief can be avoided by carefully selecting a tent site on reasonably high ground, and properly trenching around the tent. A trench should be dug several inches from the tent walls, and should have a "V" shape for good run-off. A small spade or Army surplus trenching tool is ideal for the job but a spatula or an empty can will do the trick.

A thick bed of pine needles under the tent floor and in the surrounding area will act like a storm drain in wet weather. It not only absorbs water like a sponge, but also gives you a soft cushion under your tent floor and a camp area free of mud.

Once the rain stops there will be wet clothes to dry. To hasten the process, cut off a bunch of small, leafy branches and stuff the clothes with them before they're hung up to dry. A branch stuffed in each leg of a pair of trousers or through the sleeves of a shirt before the garment is wrapped around a larger branch, will allow air to circulate freely and cut the drying time in half.

Pieces of old inner tube can protect your tent from being blown down in a strong wind. An elastic loop tied into the middle of each guy line will act as a shock absorber for strong gusts of wind. When the tent is pitched, take up on the slides only

WET BOOTS are quickly dried with hot sand or gravel. Heat material in a skillet over a fire or stove and pour into the boot. Repeat the process until the boots are dry



enough to slightly stretch the elastic link, leaving enough give to absorb any extreme tension from the gusts.

The guy lines to the main support poles are designed to exert a pull equal to the weight of the tent. The added force of the wind can create an unbalance and result in split seams. Several extra lines, rigged in different directions from each pole will absorb the additional pressure. There should be enough slack so the lines—not the tent—take the stress.

Few tent stakes will hold well in soft ground or sand. An effective device for these conditions is the *dead man's anchor*, two sticks lashed together to form a cross and buried in a shallow hole. The guy lines are tied to the center of the cross. An even more effective anchor can be fashioned from a tin pie plate by making a hole in the center and attaching the line. With either rig, the anchor is placed at a 90 degree angle to the line.

Extreme heat can turn a tent into an oven. An old blanket draped over the tent and wet down with water is a fairly efficient air conditioner. If the temperature goes the other way and you're suffering from cold feet at night, pull a large pack-sack over the bottom of your sleeping bag. It is not an electric blanket, but it helps.

On a cold night there is nothing more uncomfortable than a folding camp cot. The body compresses the insulating fibers of a sleeping bag, and although you may be warm on top, you'll be freezing under-

neath. To keep out drafts and cold seeping up from the ground, you must create a protective air pocket beneath the cot. A bunch of old newspapers will do the trick. With one edge tucked under the bag, let them drape over the sides and ends of the cot to create the air pocket.

Your gasoline stove can double as a heater if the temperature drops unexpectedly. If you have the two or three-burner gasoline stove, cover the inside of the lid and the side wind deflectors with aluminum foil and fire it up. A single-burner mountain stove takes a bit more ingenuity. Fashion some sticks into an A-frame to support a curved sheet of aluminum foil, and place the stove directly before it, allowing the heat to reflect. An open fire at the tent opening with the A-frame reflector behind it will do the same job, and if it is not too cold, a camp lantern before the reflector will give off considerable warmth. In every case it is important to keep the heater away from anything flammable and allow plenty of ventilation.

Bad weather is seldom a deterrent to the avid camper; it merely sharpens his natural abilities to take the outdoors as it comes. With the exception of the cave and the grass hut, the tent is the most ancient shelter known to man, going back in history more than 5000 years. It is still as good as it ever was, and any experienced camper can make it a comfortable home even in bad weather. ★★★

Trail Mules



BOUNDING OVER ROCKS and logs or flashing across snowy slopes, new vehicles are disturbing the quiet of the back country with the snarl and pop of gasoline engines.

Two rear wheels on a seesaw axis is the latest innovation. The 20-pound Katagote, made by Drivex Co., Madrid, Ia., has a detachable rear tread for increased traction.



KATAGOTE has second rear wheel (above), and a rubber tread that is easily attached to it in a matter of minutes



SKI PONY is a gasoline-driven propeller mounted on a single ski that has replaced the horse for ski-joring. The propeller is covered with a safety screen, and a deflector protects the skier from prop wash. Skiers are pulled along by hanging onto a pair of handles, and speeds of up to 40 m.p.h. have often been obtained

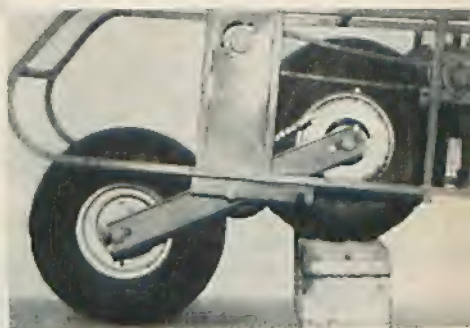


ROSS HOSS features a torque converter that adjusts the gear ratio according to the engine r.p.m. and the work load. It operates normally carrying a load of 600 pounds

Ross Craft Co. of Stinnett, Tex., has designed the Ross Hoss with a torque converter for adjusting gear ratio, and has made the third wheel detachable for conversion into a two-wheel street vehicle.

A ski attachment and rear tread turn the Pathfinder, made by Cordon Enterprises, Canoga Park, Calif., into a snowmobile.

Skiers riding behind the Ski Pony, a gas-driven propeller made by Ski Pony Co., Malone, N.Y., go up hills as fast as down.—*Stuart James*



TANDEM CRAWLER DRIVE on the Ross Hoss is a chain drive powering both rear wheels, allowing vehicle to climb obstacles with ease

PATHFINDER has the two rear wheels and the detachable traction belt. A detachable ski for the front wheel has been added for snow travel





PM Shopping Guide

Superior craftsmanship, brass fittings and adaptability are the important things to look for in—

Stoves for Campers

By Pat Snook

ONE-BURNER mountain stove operates on kerosene, and although it is often difficult to light, it burns with an extremely hot flame. Light and compact, it is an ideal stove for mountaineering or casual hiking

HIKING IN THE GRAND TETONS in the waning afternoon hours, a professional guide was lecturing on soft camping conditions, and was particularly vehement about camp stoves.

"There's always plenty of wood," he was saying. "Unless you're camping above the tree line, you can always build a good fire."

He was still going strong when we stopped for the night and made camp. As he emptied his pack he started to bring out a square metal object, then hastily replaced it.

"Wasn't that a stove?" we asked.

"What? Oh, well, yes," he admitted a bit shamefaced. "I never use it; just like to carry it with me."

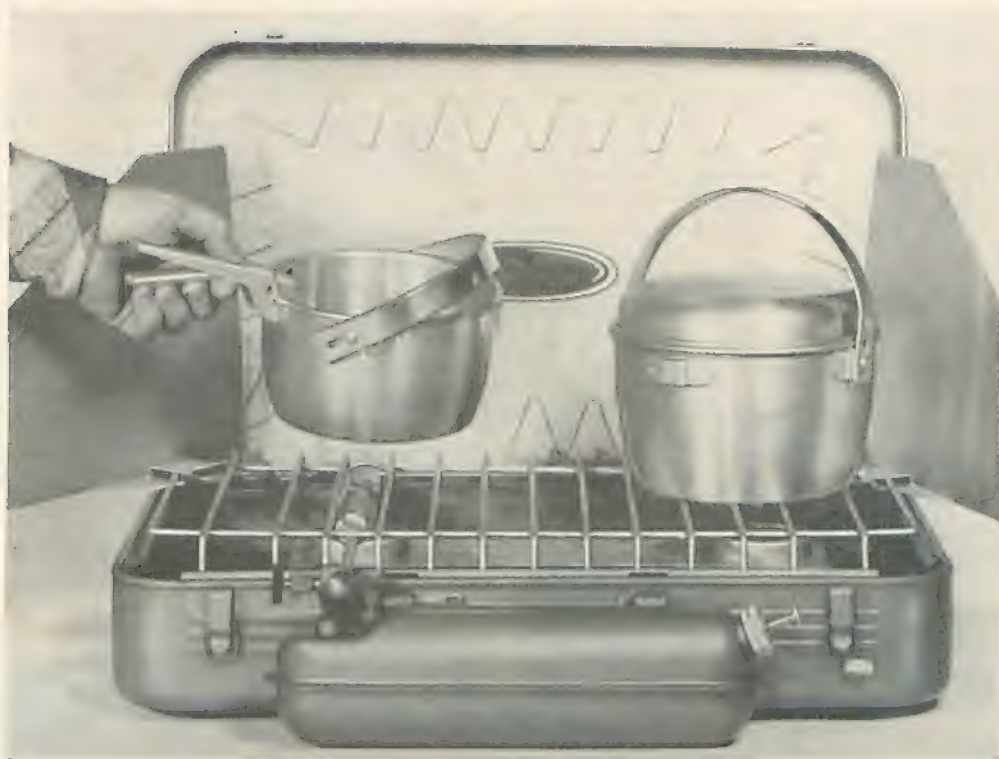
It's a rare camper today who prefers to chop and split wood for a cook fire rather than simply turn a knob and light a burner on a modern camp stove. Even the most dedicated purist generally has a small, lightweight gas burner tucked away in the

corner of his pack—just in case.

Today's camping stoves range in size from a potent little job that will fit comfortably in your hip pocket to one the size of a large suitcase. They have one, two or three burners, and burn fuel ranging from bottled propane to lighter fluid, and range in price from \$2 for a canned-heat stove to more than \$30 for an imported unit with refillable LP gas tank.

There is a stove for every purpose, from rock climbing to station-wagon camping, and the first requisite in stove selection is determining whether the unit must heat a can of soup on a rock ledge or cook a meal for a family of four. Once this basic fact is established, the requirements of quality, durability and craftsmanship are the same for all stoves.

Weight, ruggedness and reliability under adverse weather conditions are prime factors in the choice of a one-burner mountain stove. The old standby in this category



FAMILY CAMPERS require a two or three-burner stove. It is important that the burners be set far enough apart to accommodate good-sized cooking pots

is the Primus. A kerosene burner, it has invoked the hatred—over the years—of all who have tried to start it, but once it gets going it is extremely efficient, and gives off a hot flame. The alcohol stoves with gravity feed are easy to start, but a slight wind will blow them out, and they will not generate more than moderate heat at low temperatures.

One of the smallest camp stoves is the tiny Taykit. It measures only five inches long by four inches wide by two inches deep, yet it produces a hot flame and operates on lighter fluid, naphtha, gasoline or any other volatile fuel. Actually a small version of the Primus, it has no moving parts and is self-generating. To start, the filler cap is loosened to neutralize the pressure inside the tank. The cap is tightened and the tank is held between the palms of the hands. As the tank is warmed by body heat, gas is vaporized and forced up through the generator where it condenses into a small collecting dish near the top of the stove. When a small puddle accumulates it is lighted, and this heats the generator starting a steady vaporization. In a

few seconds the stove is roaring.

The Origo stove imported from Sweden, is about the size and shape of a can of tuna fish. It is actually a large wick rolled inside a can. Fuel is poured into the bottom, and it is lighted on the sides by a match. Although it does not give a particularly hot heat, it can be carried in a pocket, and is sufficient under normal weather conditions.

A compact gas stove small enough to fit the hand of an average-sized man is the Enders Benzin-Baby. Imported and sold by mail order by the American Youth Hostel Assn. in New York City for only \$4, it features a pressure tank and a small hand pump, and burns with a hot flame.

Most of these small stoves are imported from Europe and their quality is excellent. A few models imported from Japan are of slipshod construction, sacrificing quality for lower price. The tank and fittings—with exception of the burner—should be all brass, since brass is easiest to shape with less possibility of cracks, and eliminates possible weakening of pressure tank through rust. The tank should be brazed or soldered, and the only joint should be

where the end or bottom plate is fitted to the tank body.

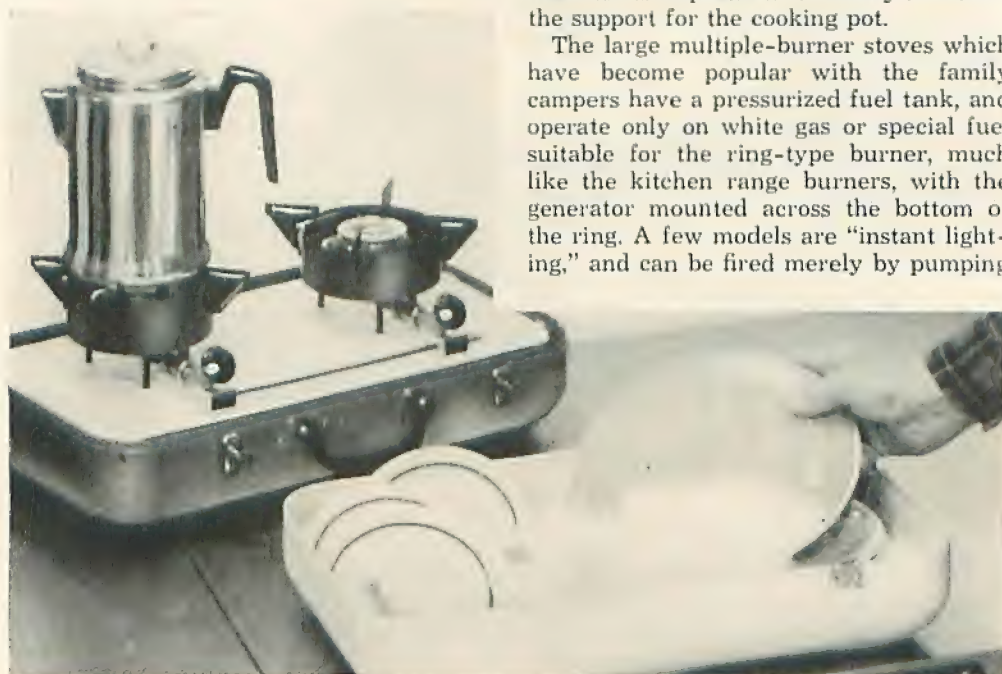
The burner orifice is critical, and if it becomes clogged the stove will not operate properly. A good stove comes equipped with a cleaning wire. On some units this is built in and by rotating the valve control, the wire is pushed up through the orifice, cleaning it automatically. Other models have the wire attached to the inside of the filler cap or it is supplied as an accessory, which consists of a metal

handle with the cleaning wire attached.

A control valve is necessary to regulate the intensity of the flame. The key, or handle, for the valve will be detachable, so it should be connected to the stove by a small chain. A lost handle means an inoperable stove. The packing around the valve stem often needs tightening, and the better stoves come equipped with a small wrench, or a valve handle that doubles as one.

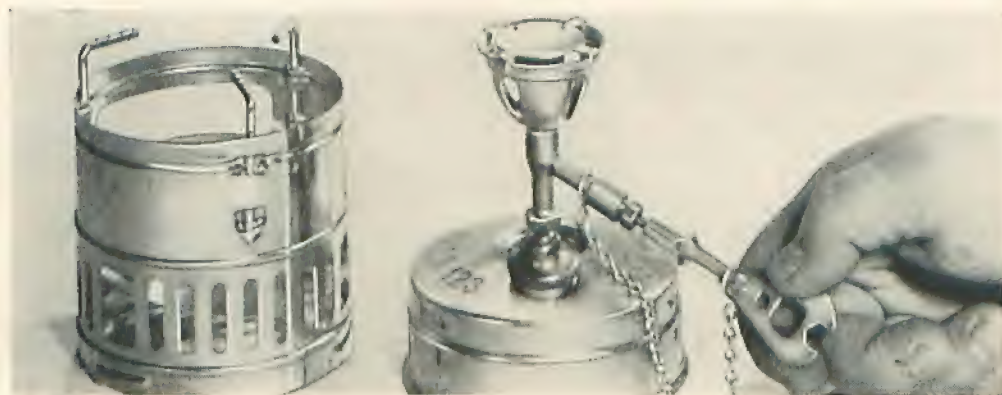
Since this type of stove is often used with little or no protection, a good wind deflector is important. It usually serves as the support for the cooking pot.

The large multiple-burner stoves which have become popular with the family campers have a pressurized fuel tank, and operate only on white gas or special fuel suitable for the ring-type burner, much like the kitchen range burners, with the generator mounted across the bottom of the ring. A few models are "instant lighting," and can be fired merely by pumping



UNIQUE VARIETY has appeared in propane stoves. This model by Humphrey Products, Kalamazoo, Mich., features cover that is used as dishwasher

COMPACT STOVES require a key for adjusting flame. Better models have the key attached with a chain and built-in wrench for adjusting the valve stem





LIDS should be attached with sturdy piano hinges, and the cooking grid should be of heavy-duty metal



BRASS FITTINGS are standard equipment on all good stoves, preventing rust and cracks in the metal

POCKET STOVE is size of tuna can. It contains a large wick and is filled with fuel from the bottom



CLOGGED BURNER orifice is cleaned with wire that is adjusted by rotating the stove's valve control



the burner. There are also a few of these stoves that will operate on regular (leaded) gasoline as well as white gas.

The three-burner stove is luxury camp cooking. You can keep the coffee hot and still have two burners free. This larger model weighs about eight to ten pounds more than a two-burner, and costs \$10 to \$15 more, but it offers added convenience for a large family.

Fuel consumption varies little from one model to the next. The average is one-third to one-fifth of a quart per hour for

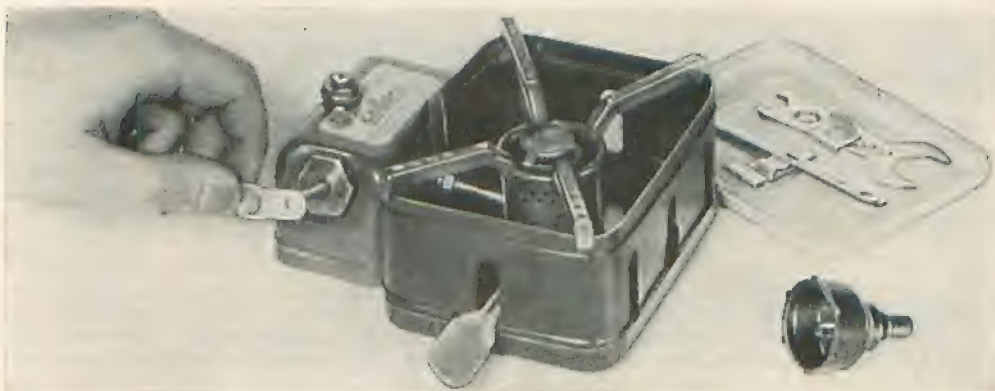
each burner which is operating.

Stoves of this type should have an easily detachable fuel tank which stores inside the case for traveling, but mounts outside, away from the flame, when the stove is set up for use. There are several stoves with the fuel tank mounted inside the body of the stove, but there should be a protective shield between the tank and the burners.

A brass fuel tank is a sign of top quality, but it is also the most expensive. Most

(Please turn to page 196)

PRESSURE STOVE with small hand pump is sold for only \$4 by American Youth Hostels. When taken apart, it stores in the small case for backpacking





WAGON-TOP SLEEPER

Bolted to a car-top carrier, this "upper berth" converts any station wagon into a five-bed motel on wheels. Walls and roof interfold flat for travel, and it sets up quick as a wink for those forty winks

By M. D. Shirley

WITH THE KIDS bedded down in the wagon and mom and dad tucked in "upstairs" on a soft inner-spring mattress, the "rugged outdoor life" becomes a treat even a city softie can appreciate. With no tent to set up, no bunking on the ground, no crawling things to worry about—you're as snug as a bug in a rug, rain or shine.

Four screen-covered circular windows let you enjoy cool, insect-free breezes on a sweltering night, and quick-fit window shutters keep you cozy and dry during a storm. A removable pullman-type ladder, which hooks over the wagon roof gutter, stows in the space between car top and sleeper while you travel.

Folded, the unit resembles a flat-bottom boat only a foot high, and because of its streamlined hull shape, you'll hardly know it's up there while you're sailing down the highway. No tarp is needed to cover it since interlapping, tape-sealed joints make

the folded sleeper completely watertight.

Erecting the sleeper is kids' play—just thirteen wing nuts and you're in business. First the two screen-door hooks on each side (which tie the roof down) are unhooked. Next the hinged filler strips on each side are swung outward. The two-part top is raised at the center hinge and propped up on each side with 13-in. lengths of 1 x 2 which are carried separately for the purpose. These props hold the two sections at the angle required for inserting the bolts of wooden tie plates in registering holes in the roof sections. Wing nuts on the inside hold the tie plates. The hinged top is now raised as a single unit and the front (door) wall is swung up so a bolt may be inserted through its top frame member and the forward flange of the roof, and secured with a fifth wing nut. Finally, the sidewalls are swung up and fastened to the side flanges with four

more wing nuts on each side, making the thirteen. In the folded position, the hinged sidewalls lay one on top of the other, flat on the 48-in. mattress, the hinged front wall rests on the sidewalls and the hinged top fits down over the whole thing like the cover on a box. There's actually enough room inside to carry a second mattress, as well as small camping gear.

First study the drawings to get a general idea of how the parts hinge and fit together. Begin by laying out full-size patterns of the curved rear ends of parts (1), (2) and (5). Note that part (2) rabbets into part (5) and that part (1) rabbets into parts (2) and (5), so that the solid lines of the pattern are not always the cutting lines. Both top and bottom edges of these six pieces—as well as parts (4)—must be rabbeted. Trace your pattern on $\frac{3}{4}$ -in. pine or fir, positioning it to produce right and left-hand members, and saw out. All rabbets are cut $\frac{1}{4}$ -in. deep (the thickness of the plywood) but vary in width.

Cut the rear-edge stiffener next from $1\frac{5}{8}$ -in.-sq. (2x2) stock, 47 in. long, and install between the ends of parts (1) with two #10 $1\frac{3}{4}$ -in. F.H. wood screws. This member also takes the screws for the piano hinge that joins the top and floor sections, later on.

Cut part (8) from $\frac{3}{4}$ -in. pine and install



PROPPED UP Roof and back panels of the sleeper are locked together at angle on each side with wooden brackets tightened on the inside with two wing nuts



THEN Roof and back are raised as single unit and front wall is swung up to support it. Single bolt through both sections holds two secure with wing nut

LOOKING LIKE a boat hull when folded, all parts pancake flat over mattress inside. Hull shape offers minimum wind resistance when traveling on highway



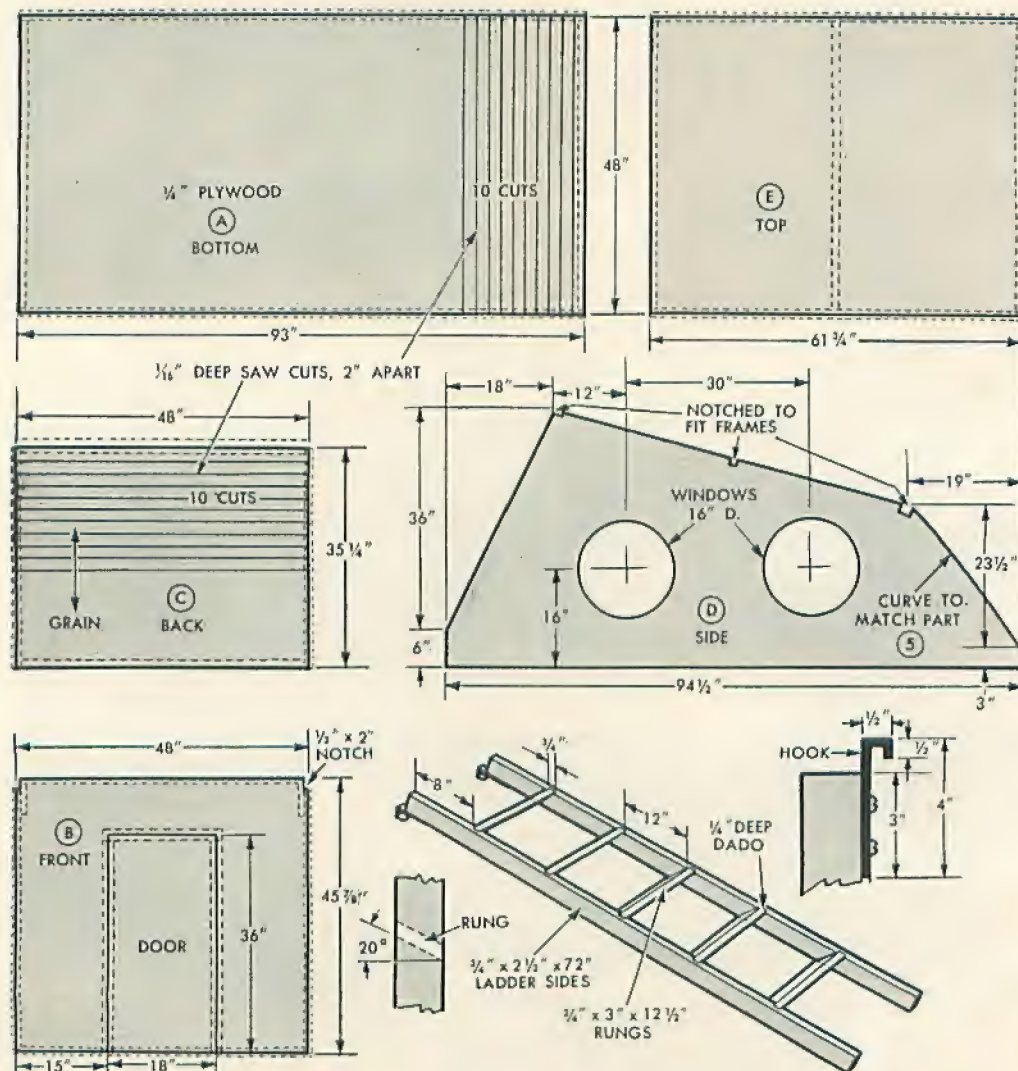


FINAL ERECTION step is swinging up sidewalls and securing with four wing nuts on inside. Note hinged spacer strip that swings outward at rear of sleeper

between parts (1) with three #10 1 $\frac{3}{4}$ -in. FH. screws at each side. Note that the top and bottom edges of this piece must first be beveled.

Ten saw kerfs $\frac{1}{16}$ in. deep and 2 in. apart are made across the rear end of panel (A) on the inside to facilitate bending the plywood around the curved end of parts (1). Turn the assembly upside down and nail the rear edge of panel (A) to the 1 $\frac{3}{8}$ -in. stiffener across the front, using #4 cement-coated nails spaced 1 in. apart. Now dampen the inside surface of the plywood by placing hot wet towels over the saw kerfs and gradually nail the panel in the rabbets and across part (8), spacing the nails now 2 in. apart. Trim off the panel flush with part (8).

Now cut three oak carrier battens $\frac{3}{4}$ x 2 $\frac{3}{4}$ x 48 $\frac{1}{2}$ in. and attach each to the bot-



tom edges of parts (1) with two #10 1 $\frac{3}{4}$ -in. FH. wood screws. Place one 30 in. from the back end and the other two 28 in. on centers. Three $\frac{1}{4}$ -in. holes are drilled through the bottom plywood and the battens for $\frac{1}{4}$ x 1 $\frac{3}{4}$ -in. carriage bolts which are used to bolt the sleeper securely to the car-top carrier brackets.

Make up the front wall and door by first cutting parts (3), (7) and (9) from $\frac{3}{4}$ -in. stock. Note that part (7) is only 2 in. wide whereas parts (3) are 2 $\frac{3}{8}$ in.; that parts (3) are chamfered at the lower corners to assume the same angle as parts (1); and that, unlike the other side members, parts (3) are rabbeted along the lower edge only. Nail parts (3) to the ends of part (7) with #8 cc nails, then add plywood panel (B) after cutting it 45 $\frac{7}{8}$ in. long and sawing out the 18 x 36-in. door. Use #4 cc nails for this, spacing them 2 in. apart. Note that the panel is recessed from the outer faces of parts (3) and (7) to form rabbets as shown in the detail on page 131. Part (9) across the top of the front wall, measures $\frac{3}{4}$ x 2 $\frac{3}{8}$ x 47 in. and has beveled top and bottom edges. This sets flush with the edge of the panel—not recessed like the other framing members. It fits between the $\frac{1}{2}$ x 2-in. notches at the upper corners. To bridge the gap between parts (3) and (9), a backing block is nailed to them both, as shown in the details. Frame the door opening with 1 x 2s extending $\frac{1}{2}$ in. into the opening to form a stop for the hinged panel. Three 3-in. T-hinges are used to hinge the front to part (8).

Attach the hinged spacers next—parts (2)—securing each with 2-in. butt hinges mounted on the outside. The sole function of these parts is to fill the space behind parts (3) and make the sleeper watertight when folded. Note here that the triangular blocks which fill the gaps that open between folded parts (4) and (5), are backed up on the inside with triangular pieces cut from scrap plywood.

Now the top assembly: Form the nose piece—part (11)—from 1 $\frac{5}{8}$ x 2-in. pine to match your full-size section. Note that it has a $\frac{1}{4}$ x $\frac{3}{4}$ -in. rabbet cut across the top. Place parts (5) in position on the assembly and drive a #12 2 $\frac{1}{2}$ -in. FH. wood screw through part (11) at each end, and into the end grain of parts (5). To prevent possible splitting of the wood, drill pilot holes for these screws.

Now cut part (10) $\frac{3}{4}$ x 1 $\frac{1}{2}$ x 47 in., bevel the top and bottom edges as required and nail between the front ends of parts (5). Again make saw kerfs on the inside of panel (C), dampen with wet towels as before and nail to part (11) first, then to the rabbets of parts (5). Follow by adding a 48-in.-long piano hinge to the front edge

BILL OF MATERIALS

Lumber—pine or fir	
2 pcs.—1 x 8 x 8'	Parts (1)
2 pcs.—1 x 4 x 4'	Parts (2)
2 pcs.—1 x 3 x 4'	Parts (3)
2 pcs.—1 x 4 x 6'	Parts (4)
2 pcs.—1 x 6 x 3'	Parts (5)
1 pc.—1 x 2 x 4'	Part (6)
1 pc.—1 x 3 x 4'	Part (7)
1 pc.—1 x 10 x 4'	Part (8)
3 pcs.—1 x 4 x 5'	Carrier battens (oak)
1 pc.—1 x 3 x 4'	Parts (9)
3 pcs.—1 x 2 x 4'	Parts (10)
1 pc.—2 x 2 x 5'	Part (11)—Oak
1 pc.—2 x 2 x 4'	Stiffener Oak
2 pcs.—1 x 2 x 5'	Roof brackets and props
Waterproof plywood—fir or mahogany	
1 pc.—4 x 8 x $\frac{1}{4}$ "	Part (A)
1 pc.—4 x 8 x $\frac{1}{4}$ "	Part (B)
1 pc.—4 x 8 x $\frac{1}{4}$ "	Part (C)
2 pcs.—4 x 8 x $\frac{1}{4}$ "	Parts (D)
1 pc.—4 x 8 x $\frac{1}{4}$ "	Part (E)

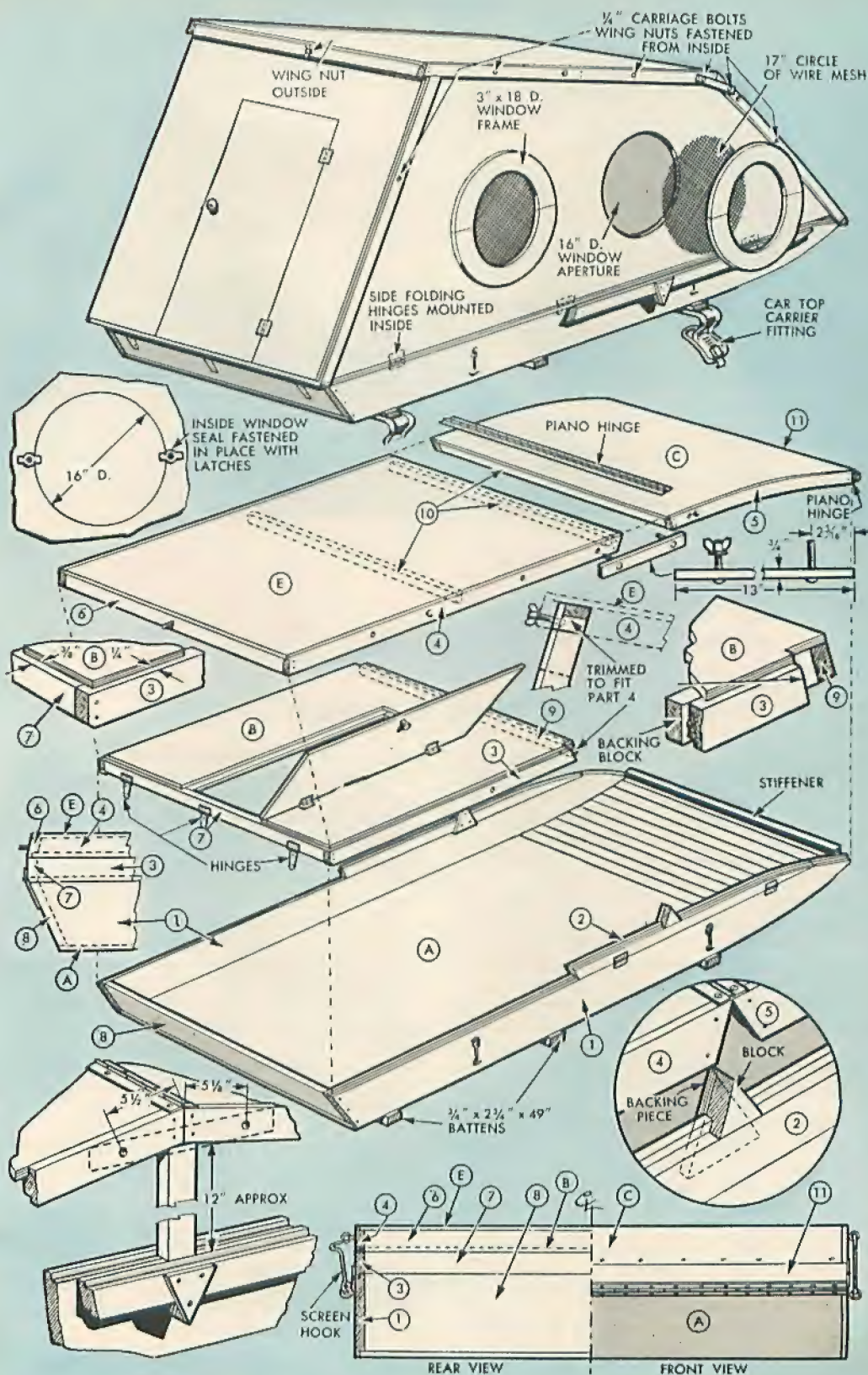
Hardware	
2 doz.—#10 x 1 $\frac{3}{4}$ " FH. wood screws	
2 each—#12 x 2 $\frac{1}{2}$ " FH. wood screws	
9 each— $\frac{1}{4}$ " x 1 $\frac{1}{2}$ "—Carriage bolts	
6 each— $\frac{1}{4}$ " x 1 $\frac{3}{4}$ "—Carriage bolts	
4 each— $\frac{1}{4}$ " x 2"—Carriage bolts	
2 lbs.—#4 cement-coated nails	
$\frac{1}{2}$ lb.—#8 cement-coated nails	
3 each—3" T-hinges	
5 pr.—2" butt hinges	
2 each—Piano hinges 48"	
8 ft.—1" rubber electrical tape	
8 each—Turnbuckle latches	
13 each— $\frac{1}{4}$ " wingnuts	
13 each— $\frac{1}{4}$ " washers	
4 each—Screen door hooks and eyes	
5 ft.—24" screen wire	
20 ft. Water repellent tape 3" wide	
1 qt. Aircraft dope adhesive	

and make it waterproof by placing a strip of rubber electrical tape between the hinge and the plywood.

Assembly of the forward top panel presents no problems, except that the top and bottom edges of part (6) and one of the parts (10) must be beveled before they're nailed between parts (4); in addition, part (6) must have a $\frac{1}{4}$ x $\frac{1}{2}$ in. rabbet cut in its beveled bottom edge. The center brace (another 10) needs no bevels; it simply fits between the rabbets.

Now hinge the back wall and top together, placing rubber tape under the hinge leaf as before. Holes for the tie-plate carriage bolts are made through parts (4) and (5) on each side of the hinged joint. Finally, this top-and-back assembly is joined to the bottom assembly with a piano hinge across the joint between the stiffener and nose piece—part (11).

The two sidewalls, parts (D), are cut according to the pattern. The cutouts from the circular windows are saved and used as bad-weather shutters, secured with turnbuckles. Aluminum or plastic mesh is tacked over the windows and the tacked edges are covered with overlapping circular trim pieces. The sidewalls are hinged to the inside faces of parts (1), mounting





PAINTING YOUR FIBERGLAS BOAT

By David A. Kendall

SUPPOSE you've just purchased a new fiberglass boat. Naturally, you're pleased with the sparkling good looks of your new craft. You'd like to keep her looking that way. And if you care about her resale value, it's important that you do so.

After about five years, however, you'll probably become dissatisfied with your boat's appearance. Wind, water, hard shoes on decks, sand and sun will have taken their toll. Your boat won't match your friend's wooden boat for whiteness of topsides, sparkle of deck color, general snap-piness. The reasons are very simple.

If you've ever owned a wooden boat, you know that each spring you painted her hull, freshened her decks. If you knocked her against a dock or float and came away with a big black streak, it didn't matter too much. After all, next spring you'd sand the streak off and paint over. But if you mar your fiberglass boat's white topsides, that stain will remain until you scrub it off. And certain stains just won't come off.

Take the black creosote preservative with which most pilings are coated. You can remove most of a creosote stain with solvent, perhaps a little more with a good gritty bleaching cleanser or a soap pad.

But some residual brown stain remains, seemingly bonded with the gel coat. The same is true of stains from water-line "moss" found on boats lying at anchor in salt water. That greenish tinge can't be removed with normal elbow grease. So, too, with the fuel slick found on every power-boat harbor.

Of course there is a way to remove these stains. It's the same way you removed stains from your wooden boat—by sanding. In the case of a fiberglass boat, you use a fine emery cloth or a wet-dry sandpaper. And while the stains do disappear, so does a small portion of the gel coat. On the wooden boat you were sanding away paint which you later replaced. You normally don't think of replacing the gel coat on your fiberglass boat.

So, after five years or so, you'll begin to notice patches of the grayish resin-impregnated fiberglass matting showing just beneath the gel coat in those areas which accrue the greatest wear—or the most frequent stains, requiring the most stringent cleansing methods. If you value the ship-shape appearance of your fiberglass boat, you'll want to replace that gel coat, or in everyday language, paint.

I can just hear the anguished screams: "Whaddaya mean paint? I bought a fiberglass boat because it wasn't *ever* supposed to need painting."

First, remember I said that if you value the *appearance* of your boat, you'll *want* to paint. The boat won't deteriorate if you don't paint it. It'll just look sloppy.

This brings us to an interesting point—the maintenance requirements of fiberglass boats as claimed by their manufacturers. Early fiberglass molders went crazy with "no maintenance" claims—no calking, no sanding, no painting. They were right on the first count, but, as they soon found out, way off base with the second and third.

Today, manufacturers are claiming "low maintenance" for their craft, and they're right. The maintenance is negligible, but it's still maintenance—in certain aspects, the same type of maintenance you'd expect to put into any boat.

EVERYDAY CARE. Let's assume you're a conscientious fellow who believes in a regular scrub-down schedule. How often? Well, once a week will do very nicely, though it may be an impractical goal.

If you trail your boat to a freshwater launching site and bring her home after use, you'll want to flush her down with the hose each time. To do a really good job, invest in one of those whirl-brushes, and swab down with soap and water as you would your car. Every so often, hit the interior the same way. Tilt up the trailer tongue to a good angle, open the transom drain plug and go to it. Give the seats a good going over, maybe even wax them once a month or so. Flush off varnished bright-work with fresh water and wipe dry.

Salt water boatmen have to work just that much harder, especially those who keep their boats in the water all season long. Scrub down the bottom of your boat with a stiff nylon brush periodically; use a good, gritty cleanser and soap pads on the topsides, especially at the water line. Pull the boat out of the water half-way through the season for a mid-season clean-up. Sand and repaint her bottom with anti-fouling paint. Clean her topsides and decks with lots of fresh water to loosen salt crust, and of course, rinse her and sponge her down with fresh water at the dock after each run. Wax her topsides at spring fitting out, and again at midseason haul out to close the pores of the gel coat against stains and salt.

But no matter how conscientious you are about everyday maintenance, the day will come when you have to think about painting. Two springs ago I decided to paint my own five-year-old fiberglass sailboat. The white topsides were stained,

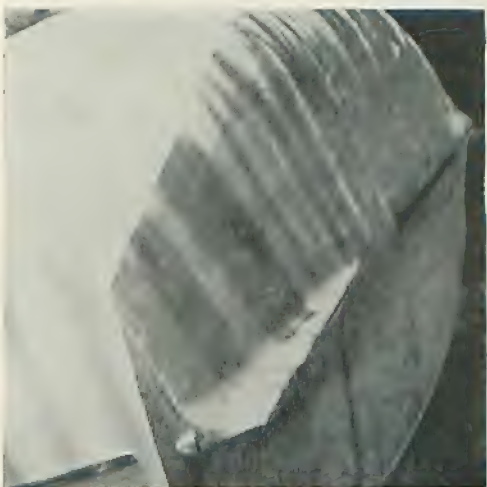


REGULAR MAINTENANCE requires scrubbing hull at least twice a season to prevent harmful fouling



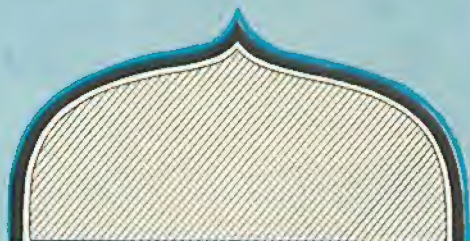
SCRUB-DOWN is easy if you use a stiff nylon brush and plenty of soap. Brillo pads also come in handy

READY TO BEGIN, the hull has been scrubbed to remove bottom growth so that you can start sanding

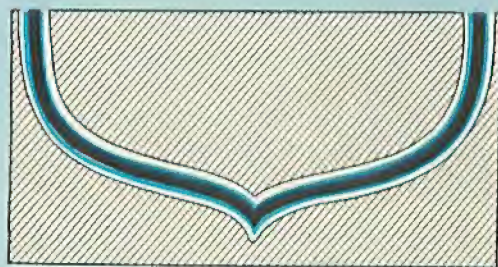


HOW A FIBERGLAS BOAT IS MADE

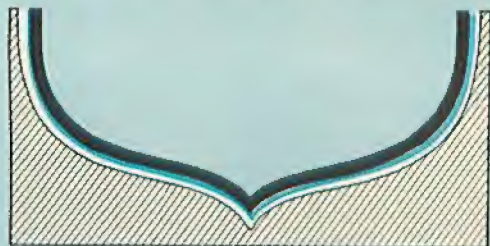
Fiberglass boat hulls are molded in a single piece using one of the three "lay-up" methods described below. Deck and cabin units are molded in a separate piece which is then bonded to the hull. Correctly termed "fiberglass-reinforced plastic," the manufacturing process involves impregnating fiberglass (roving, mat or woven cloth of spun glass fibers) with a resin glue which is a member of the plastics family



COLD LAY-UP OVER MALE FORM is the simplest method of copying an existing hull in a slightly larger size, and was often used by design pirates in the early days of fiberglass. The exterior surface always requires extensive sanding, polishing and buffing



HOT PRESSURE DOUBLEFORM layup is extremely expensive because it requires special matched molds and a press. However, with a gel coat on both surfaces, the hull comes from the molds finished on both sides and requires no further sanding nor buffing



COLD LAY-UP IN FEMALE MOLD is today's most common manufacturing method because it's inexpensive and yields a finished exterior surface. A parting agent sprayed inside the mold assures easy break-away of the cured hull, and the pigmented gel coat of resin is simply laid over this parting agent. It's a fair bet that your boat was made in this way, since this procedure is used with 95 out of 100 boats



POWER SANDER covers large areas quickly. You can do the fill-in sanding by hand to finish the job

gouged, mottled; the gray decks and cuddy cabin had taken on an unattractive chalky look. I had a row of thumb-nail-sized chips at the deck line gained in an encounter with a wooden boat during a hurricane (the other boat came out second best, by the way). All in all, my boat was looking pretty seedy.

It cost me plenty of time, elbowgrease and money to learn how the job should be done. You can avoid the pitfalls that I fell into by following these instructions.

PLAN AHEAD. First, analyze the work carefully and plan your time schedules accordingly. Once you begin you've got to carry through—no knocking off to take a spin through the countryside with mom and the kids halfway through.

Second, forget everything you ever knew about painting wooden boats, houses or what have you. However, if you've worked with varnish or brushing lacquer, the experience will come in handy.

Finally, for the love of Pete, *read the directions on the products you're buying while you're still in the store.* Then discuss your particular job with a marine dealer, going over temperatures, time factors and your own experience. If he suggests that you'll need an additional product or that you'd better take an additional step, listen to him well and take his word for it. He's probably right.

Unfortunately I didn't do all these things because I knew it all. And the topsides of my beautifully-prepared-and-sanded boat came out looking like an old orange peel, with holidays and runs all over the place. Now, the paint you use for fiberglass topsides is expensive—about \$5.00 a quart—and terribly, terribly hard. My boat is 16 feet long and it took me, by



ANTI-FOULING PAINT for fiberglass boats is vinyl-based and goes on in same way as brushing lacquer



TO FILL GOUGES, use a resin-type filler mixed in small batches. Apply and shape with putty knife

conservative estimate, one hour for every foot of her length to sand her down with a power sander just so I could start at the beginning again. It cost me another five bucks for paint too. That hurt.

So here's what I suggest you do.

SURVEY YOUR BOAT. Go over your boat from stem to stern, noting all chips, gouges and cracks in the gel coat. Certain early fiberglass hulls had weak gel coats—a couple of seasons of use and they developed hairline cracks webbing out from points of stress and impact all over the hull. If your boat is one of these, don't worry about it overmuch, since this is just a surface condition and has almost no effect on the boat's structural strength. Paint will cover the crazing.

Gouges and chips can be filled in easily. If you do the job right, you'll never know they were there.

PREPARE THE SURFACES. The special column on lay-up methods points out that during the building process molds are sprayed with a parting agent to allow finished hulls to slip free cleanly. This parting agent contains carnuba wax, among other things, and as you know, wax and paint don't mix. In order to achieve a good paint bond, you'll have to remove this wax and roughen the surface, actually a one-step sanding operation.

Use a power sander (pad, disk or belt) for large areas and do the fill-in sanding afterward by hand. Sand across the vertical plane of areas to be painted. Use a medium-fine open-coat paper. As a safety measure, especially when working indoors, cover your mouth and nose with a painter's mask or kerchief to avoid breathing in the talcum-fine resin dust.

Now for the chips and gouges. There

are many fine products on the market for filling these. Prepare the damaged areas first by sanding and, in the case of large gouges, under-cutting the edges. Then you're ready to fill them.

You may decide to use the creamy epoxy resin which approximates the material from which the boat was made. This is the strongest but also most difficult way. You'll find that the resin runs on vertical areas, and it's virtually impossible to build up an edge or curve in the time you'll want to give the project.

Fortunately, there are two epoxy-based putty-like substances made by Interlux and Marine-Tex which provide an easier answer to the problem. These involve mixing a base material with the catalytic agent necessary for curing. Mix according to directions and you'll find that they are very strong and satisfactory, allowing you to build up edge and curve layer by layer. Allow considerable time for curing.

To repair those collision nicks at the deck line of my own boat, I used still another epoxy-based filler product. My marine dealer doesn't carry it and perhaps yours won't either, but it is available from large paint stores and auto-repair supply houses. The product, called Rez-Zin, is a polyester putty originally developed for leading-in collision damage on cars, I understand. It's equally applicable to the same type of repairs on boats.

Sold in a kit, it's extremely thick, strong, cures to a sanding finish in about twenty minutes and best of all, it's inexpensive—about \$2.00 for a generous kit. To mix, you simply drop a golf-ball-sized glob of the base material on a coffee-can top or other flat surface, add the specified amount of catalyst from a dropper-tube, blend



CAREFUL SANDING of the filler used in gouges will make the patch invisible once you have applied paint



ONCE CURED, the filler sands off easily and feathers out to form a smooth joint. Paint will conceal it

well and apply. It sands very well, feathering out to form a completely smooth joint. It only comes in gray, however, so it can only be used in cases where the repaired area will be painted afterwards.

Proper priming is a step which is often overlooked in painting, and it's extremely important in painting fiberglass. The primer provides a surface to which the paint will adhere firmly, and this extra undercoat can save you much grief later. The paints themselves seem to have very little lateral stability—they readily run and sag.

PAINTING THE BOTTOM. If you're a salt water boatman, you know that each season you've got to protect the bottom of your boat from fouling—the accumulation of marine growth, barnacles, seaweed, etc. Now barnacles won't hurt your fiberglass boat, but they will slow it down and affect the performance.

On wooden boats you used a relatively cheap copper bottom paint. Forget it. You're in for a vinyl-based anti-fouling paint now. This may be thinned with acetone, but most manufacturers don't recommend thinning, so you're better off to use it just as it comes from the can—thick as glue.

As far as I can tell, the vinyl bottom paints are basically plastic-based lacquers. You've got to flow them on. And the first coat isn't the critical one in this respect; it's the second one you have to worry about. Vinyl paints retain their wet edge pretty well, but I'd recommend that you step on it once you've begun and do the whole boat without stopping. Flowing into a dry edge without lifting the paint isn't easy. The second and subsequent coats should be put on with a light hand, much speed, delicacy and no brushing out.

There isn't much more to say about these bottom paints except that they're good, will keep the boat's bottom clean and should go into the water dry.

Incidentally, don't let the color charts fool you. The paint will probably look many shades darker than the chart shows, but don't worry. It will lighten up as soon as it hits the water.

And a word of warning, especially if you have a fast boat. The bottom is the first area where poor surface preparation will make itself known. All bottom paints are exfoliating to some degree—they are designed to flake away in minute amounts, carrying the marine growth with the flakes. If you haven't properly prepared your boat's bottom, the paint will exfoliate in a big, big way—in long sheets and ribbons the first time you open the throttle wide. Do it right the first time.

PAINTING ABOVE THE WATERLINE. Temperature is especially important with topside and deck paints. The manufacturers say no painting if it's cold, hot or damp. If you plan to paint your boat outdoors, wait for a middle-60s day.

Once you begin painting, go, go, go. Unlike the bottom paint, the product you'll be using is an epoxy-based paint—basically, a thinned-down pigmented version of the resin used to mold the hull. You are now actually adding a bonded resin surface to the hull of your boat, replacing the gel coat you sanded away. This epoxy paint is hard, beautifully glossy and wonderfully long-lived.

Use a vertical brush stroke on vertical areas. This will help stop sagging and running, and also prevent holidays from showing up later. Specks and splatters of other paints should be all sanded off before you start as they tend to melt and spread through the epoxy. Don't use too much paint on your brush; thickly applied areas are most likely to run. Use a good brush that won't shed, and don't brush out any more than absolutely necessary.

Of primary importance here is the cur-

(Please turn to page 192)

Rear Chute for Radial Saw Traps Sawdust

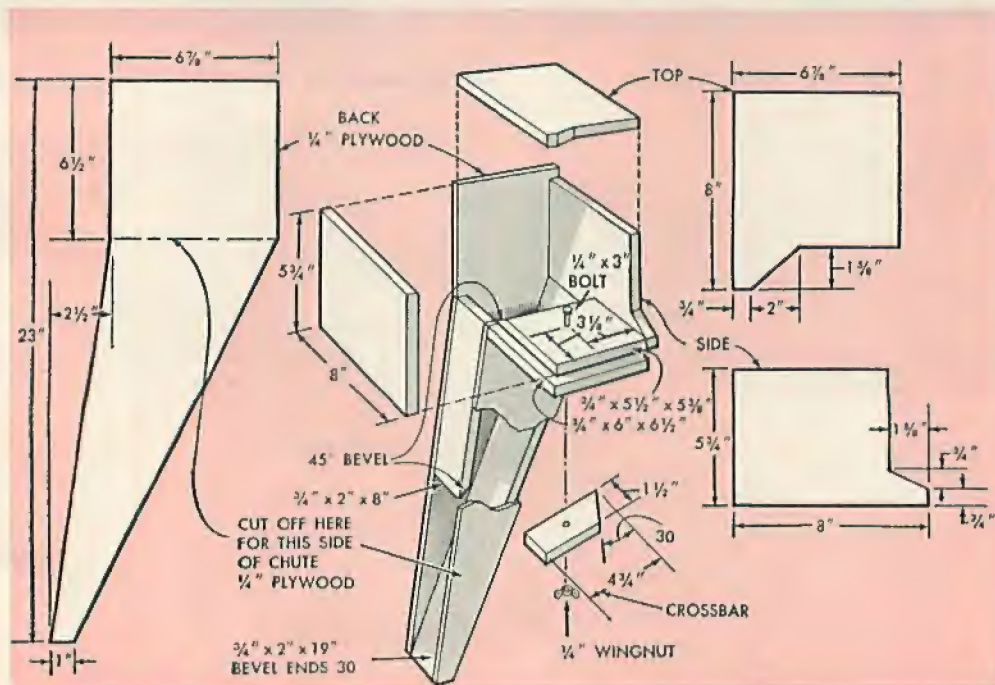
EVEN WITH a heavy duty shop-type vacuum cleaner attachment clamped to the regular discharge spout of a radial-arm saw, you can't catch the sawdust that is thrown by the blade to the rear of the saw. The chips and sawdust that normally pile up at the back of the saw are a chore to sweep up, but it's easier than you might realize to have a spic and span shop, even though you may be reluctant to wield a broom as often as you should.

All that's needed is a simple chute having a box-shaped top. The force with which the blade throws the sawdust clear of the work is utilized to direct the dust into the top of the chute, from where it is funneled into a cardboard carton.

Constructing the chute is an easy job and it may not require the purchase of any material since it can be built entirely from scrap size pieces of $\frac{3}{4}$ -in. solid stock and $\frac{1}{4}$ -in. plywood cut to the size specified in the drawing.

The catcher is positioned directly behind the saw blade and is attached to the table frame of the saw by means of a crossbar and wing nut.

The dimensions given will be found suitable for most radial-arm saws, though you may possibly find that the table thickness of your saw requires a change in measurement so that the catcher will fit on the table properly.—Art Youngquist





"WATERBUG"

By W. Clyde Lammey

Designed by Robert Woolson

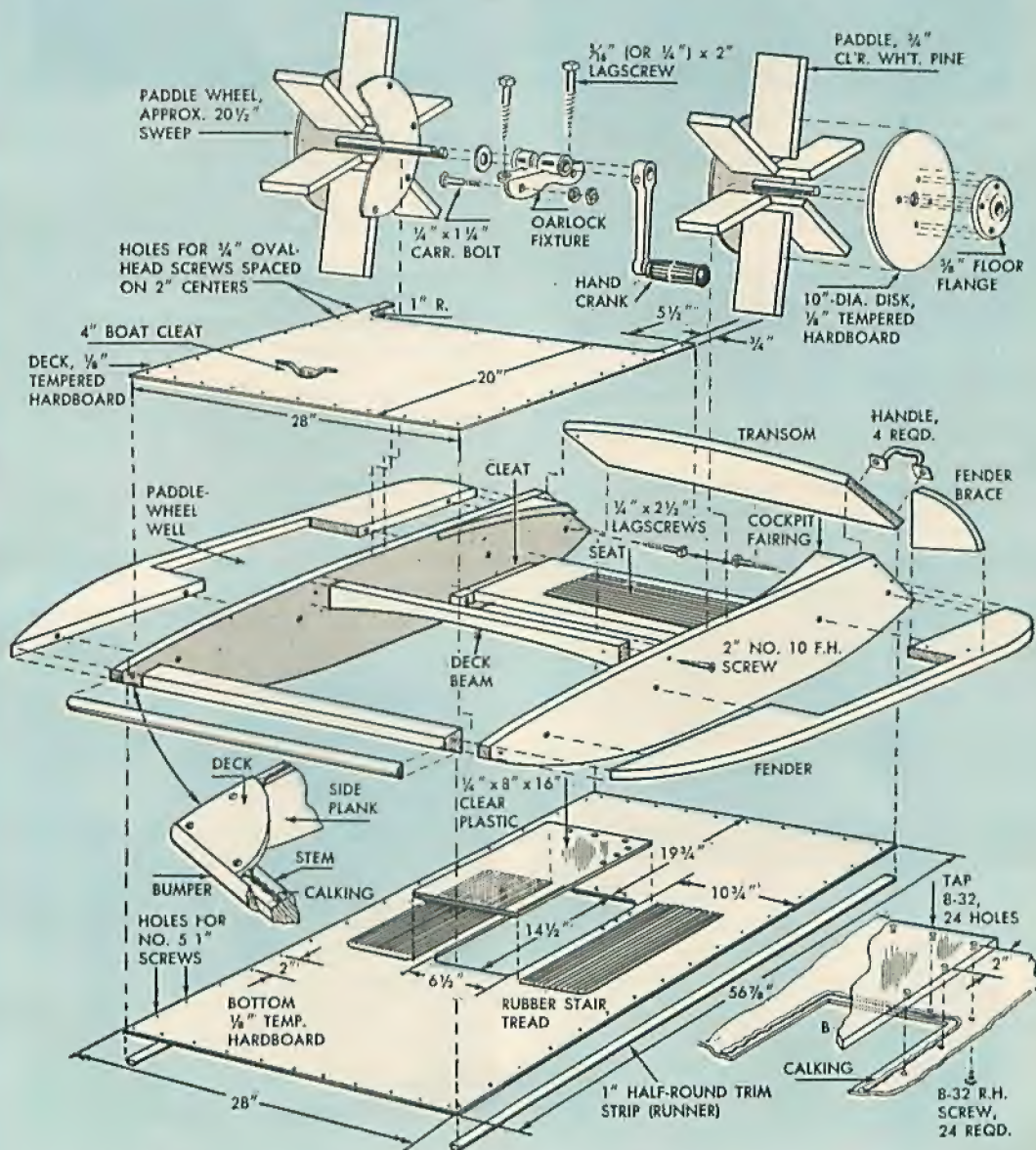
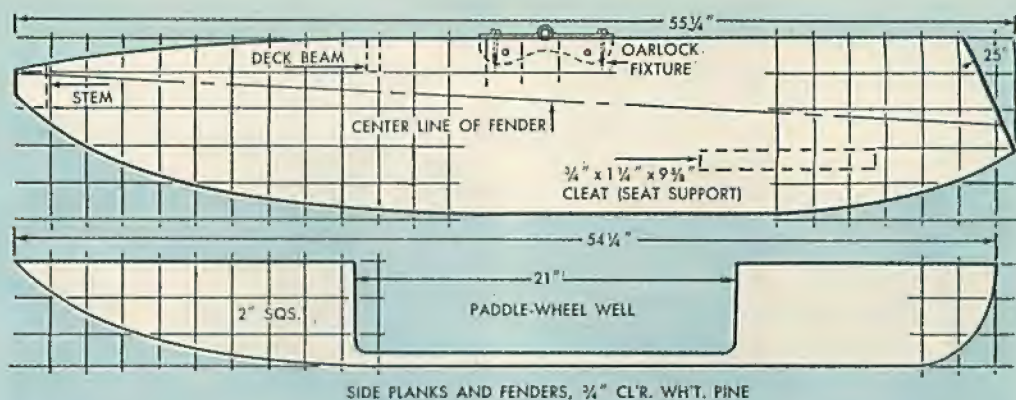
SAFE AS ANY HULL afloat, *Waterbug* won't flip over frontwards, backwards or sideways. It can ride out a rough "sea" in a fair size pond, and it can be launched in any wading water that's over ankle deep. Just about every part needed except the bike-pedal cranks, handlebar grips and the oarlock fixtures that serve as bearings for the paddle wheels, are available from your local lumber and hardware dealers.

One good look at the details and you have a clear idea of the construction of *Waterbug*. Note at the outset that the original *Waterbug* was equipped with a "glass" bottom window for sub-surface study of marine life such as crawfish, chance salamanders, minnow schools and the like. It's made by cutting an opening in the bottom and screwing clear plastic over it in a bed of calking compound. Be sure to round any sharp edges with a file.

There are several points in the construction which should be noted before you cut

stock: First of all, the stem, or nosepiece, the deck beam, seat and transom should be cut to precisely the same length and square at the ends so that you get a true fit of the joints. The seat board can be cut about $\frac{1}{8}$ in. less for easier installation, if desired. The details at the top of the opposite page give the finished lengths of the side planks and fenders. When rough cutting to the patterns, saw these parts a trifle over, about $\frac{1}{8}$ in., so that you have stock left for fairing in to get a good fit of the bottom panel, the deck and transom at the joints. This is quite important as otherwise you may come up a trifle under especially when fairing the top and bottom edges of the side planks to obtain a true curve and a tight fit of the parts. The sectional size of the stem and deck beam is given in the details, and you plot the curves of the beam and transom from the cross-hatched detail on page 143.

Good waterproof bottom and deck joints were made in the original *Waterbug* sim-





DO A CAREFUL JOB of fairing in deck and bottom to assure water-tight joints. Even a slight offset at a joint may result in a leak. Be sure curves are uniform

ply by laying a bead of calking compound on one joining surface. The same water-proofer is used in the transom joints to the side planks. Such joints will not leak if the fit is true along the length. However, if you prefer you can use a dry-mix (powdered) waterproof resin glue instead of the calking compound. Again make certain before joining that the meeting surfaces are properly faired to give a true, tight joint. Mix the waterproof glue according

HANDLES ATTACHED to nosedpiece forward and to sternboard aft provide for easy transport, launching and beaching of Waterbug. Use galvanized handles

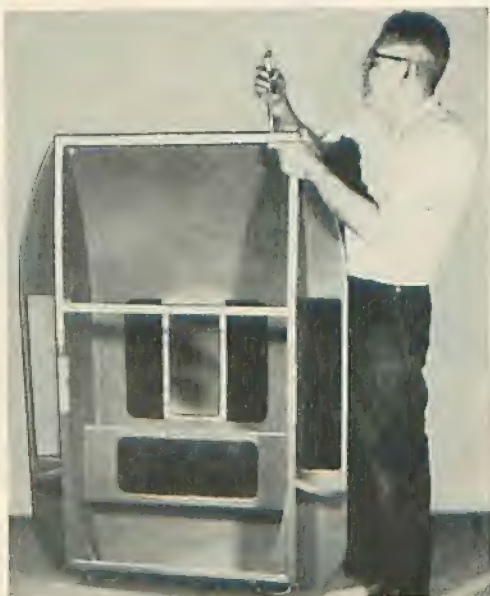


IF YOU PREFER, small machine screws with nuts may be used to draw up window tight in bed of calking instead of tapping holes in the plastic as detailed

to the instructions on the container and then coat both joining surfaces quite liberally. Join the parts immediately and drive the screws home, spacing the screws as indicated in the details.

Note in the pulled-apart view that the fenders are joined to the side planks with lag screws. Only two are shown in the detail but four lag screws are required for joining each fender, the holes being located approximately as indicated. The location

HARDWOOD BUMPER STRIP is attached to nosedpiece with heavy screws. Top edge of bumper extends $\frac{1}{8}$ in. to form rabbet for seating forward end of deck

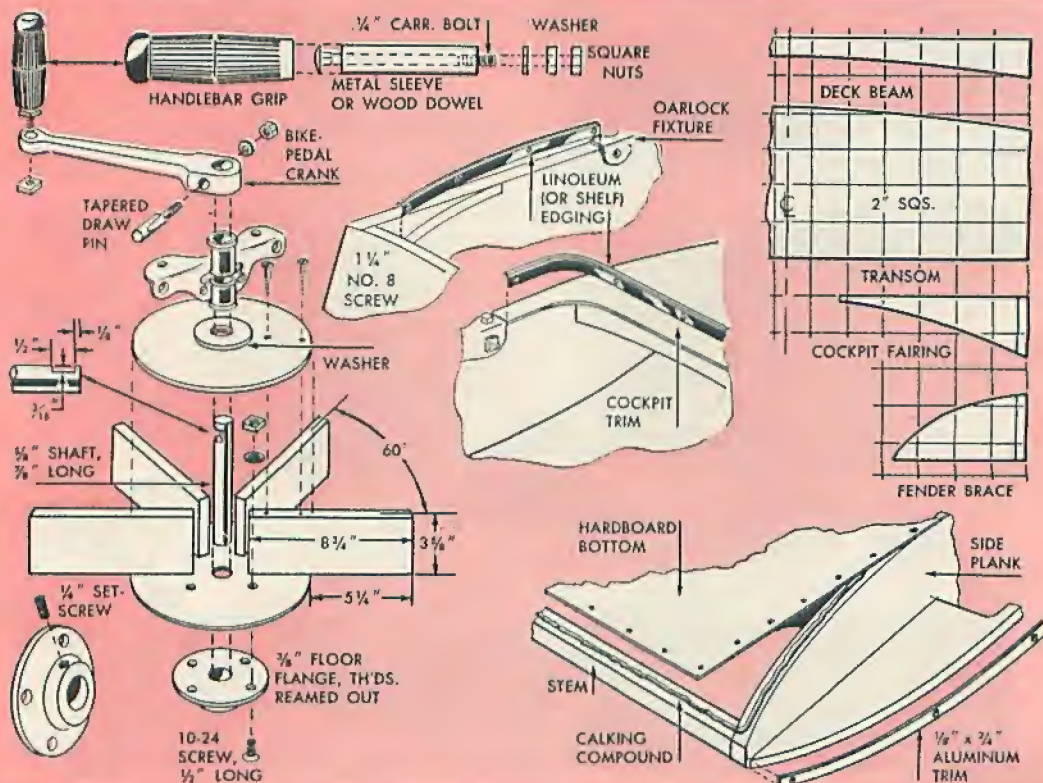


of each fender on the side plank is shown in the top detail, page 141. The bumper and runners should be made from hardwood such as oak, and attached with flat-head screws, the heads countersunk flush. Installing the cockpit fairing, the cockpit and fender trim and the four lift handles finishes the hull ready for the paddle wheels. These are duplicates, each having six paddles located on 60-degree centers. The paddles are cut from 1 x 4 stock and each set of six paddles is joined to two 10-in. disks of $\frac{1}{8}$ -in. tempered hardboard with waterproof glue and screws. Two points to watch when assembling the wheels are uniformity in width of the paddles and the spacing. Also, one must make sure of the projection of the paddles so that the outer ends describe a true circle when the wheel is turned. Your 1 x 4 from which the paddles are cut should be free from knots, straight-grained, and not cupped across the width.

Note that the paddle-wheel shaft has a flat filed near one end to take the draw pin which locks the bike pedal crank in place. The cranks are assembled with handles which turn. Each consists of a handlebar grip (bike replacement part), a carriage

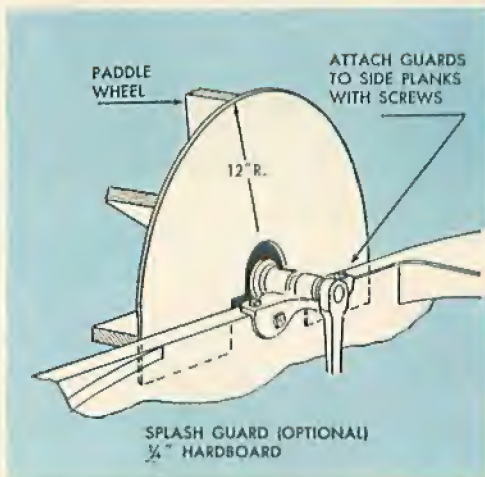


CHECK FIT OF DECK before installing permanently. Make sure screw holes are uniformly spaced and that there are no skips in calking seal. Sand edges flush





PADDLE-WHEEL SHAFT above, turns in bearing adapted from oarlock fixture. Latter attached with screws and bolts. Below, under some conditions water may be splashed inboard by paddle wheels. Install guard as detailed, screwing it to side planking

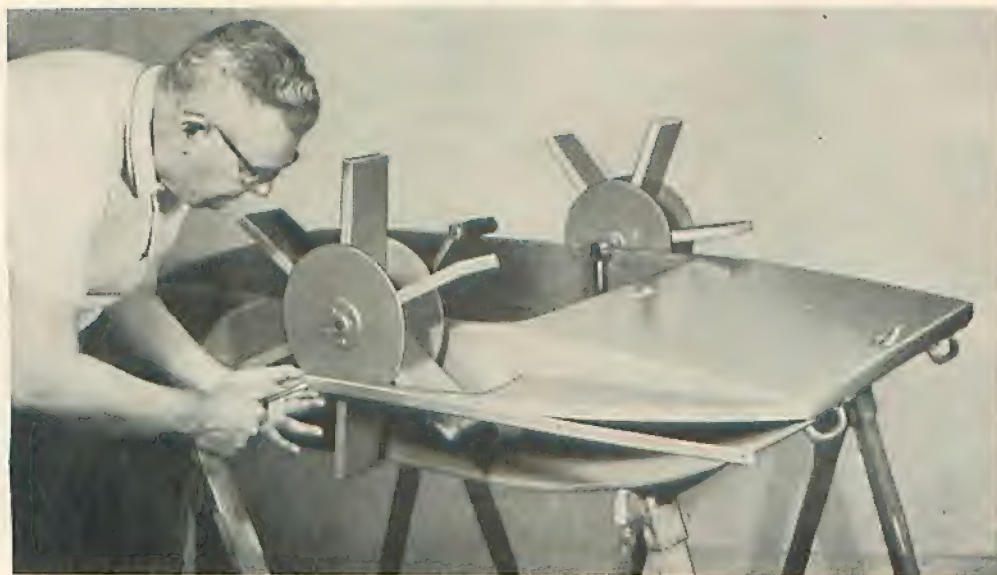


bolt, a metal sleeve—or a sleeve made by center-drilling a length of dowel—which fits tightly inside the handlebar grip, a washer and two square nuts. When assembled as indicated the grip should turn freely on the bolt but to achieve this you may have to grind off the squared section under the head of the bolt and also grind down the bolt head slightly to assure its turning freely inside the grip. When attaching to the crank (also a bike replacement part) you run one nut down on the threads over the washer, insert the threaded end of the bolt through the smaller hole in the crank, run on the second nut and tighten it.

Paddle-wheel bearings are oarlock fixtures adapted to the purpose. You will have to ream out the slightly tapered hole to take the $\frac{5}{8}$ -in.-diameter wheel shaft. The adapted bearings are attached to the side planks, each with two bolts and two lagscrews. The outer ends of the wheel shafts fit into $\frac{3}{8}$ -in. pipe flanges, the threads being reamed out to take the shaft ends in a snug, sliding fit. The hub of each flange is tapped for a hollow setscrew.

When the paddler is going all out in a breeze the paddle wheels may lift a little water into the bilge. This can be largely prevented by installing wheel guards as shown at the left. This feature is, of course, optional and there is one disadvantage: when there's wind, the guards can act as sails, may possibly make the boat less easy to control. ★ ★ ★

FENDERS ARE EDGED with aluminum rub strips. Use aluminum screws spaced about 6 in. apart. Rub strips extend full length of fender for maximum protection



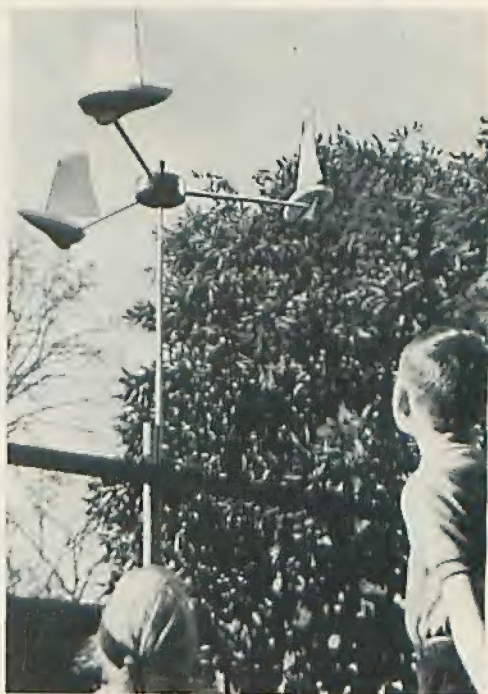
SHIP CAROUSEL SAILS IN THE WIND

SAILING IN CIRCLES, the three tiny ships on this see-worthy garden mobile require no helmsmen to hold their course. Due to the set of the sheet-aluminum sails, the carousel spins merrily in the slightest breeze, adding a fascinating touch of action and color to any part of your lawn or garden. Best of all, it's extremely easy to make since very few of the dimensions are critical and only common tools are required.

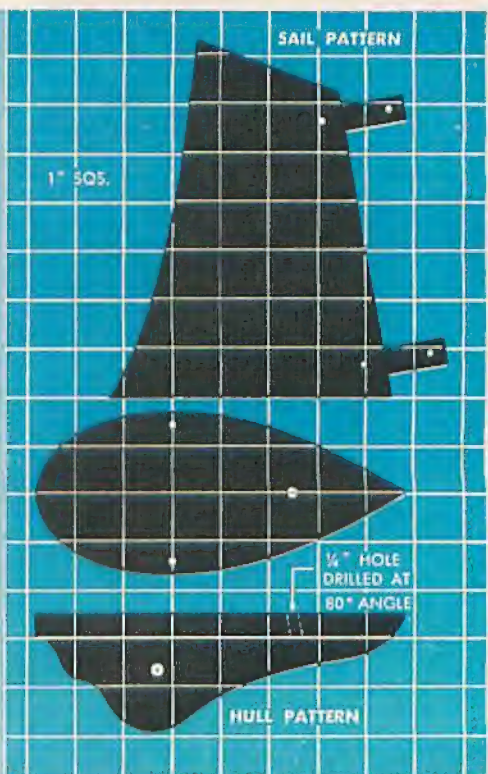
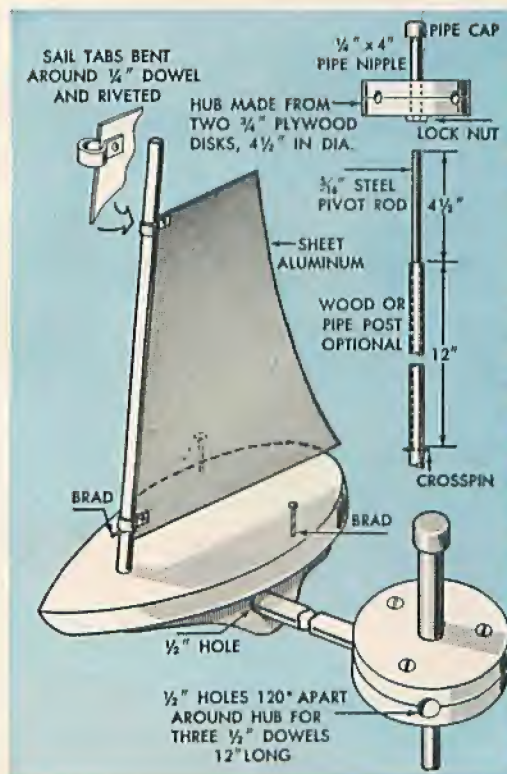
Use waterproof glue and three screws to assemble the two $\frac{3}{4}$ -in. plywood disks which make up the hub. Next, drill a hole in the exact center for a 4-in. length of $\frac{1}{4}$ -in. pipe nipple. This nipple is fitted with a pipe cap at the top to serve as a bearing for the $\frac{3}{16}$ -in. pivot rod. A locknut at the bottom supports the hub. You can use a wooden post or a length of $\frac{1}{4}$ -in. pipe as a mast on which to mount the rod.

Cut and assemble the three ships as shown in the drawings below, painting the hulls red and white. Then mount the ships on the arms temporarily and give the unit a trial spin. If it's not properly balanced, try shortening one of the arms. Once balanced, take the carousel apart and reassemble it permanently with glue.

—J. W. Clement



ROUND AND ROUND she goes, and where she stops only the wind knows. The effect is hypnotic

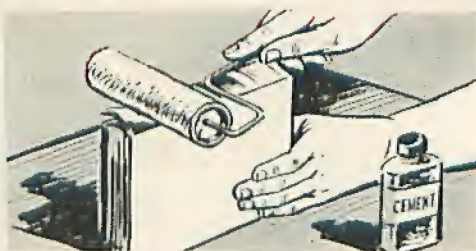




NEXT TIME YOU PAINT the porch floor and steps and wonder how to warn visitors, borrow a folding tray table from your wife. With the legs tied together as shown, a "wet paint" sign can be taped to the hanging tray, and the stand itself will stop nonbelievers

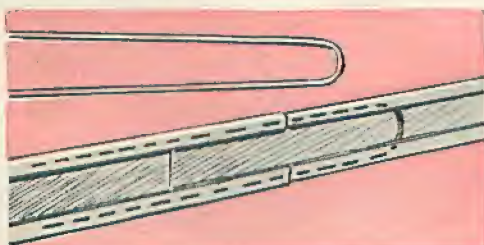
Solving HOME PROBLEMS

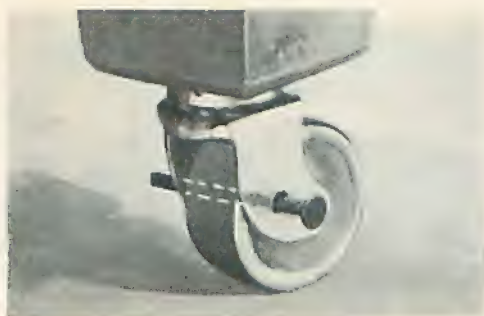
DON'T THROW AWAY that old belt. When preparing to move shrubs, it will come in handy for drawing branches together for tying before digging up roots



MENDING OLD BINDINGS is a minutes-only job if you coat the surfaces with contact cement and then press the materials together with an old paint roller

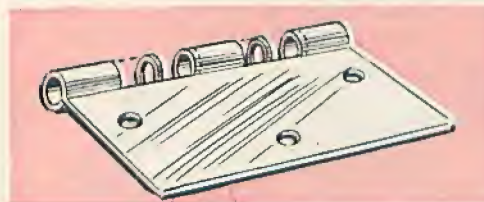
ON-THE-SPOT SPLINT for sagging curtain rod can be made by bending a 14-in. length of coat-hanger wire into a hairpin shape and springing it into the slots





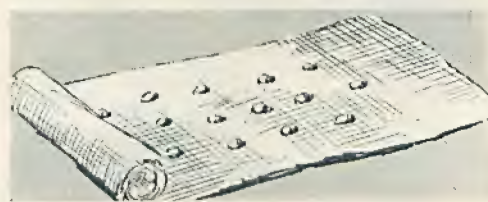
TO MAKE CASTERS on your power-tool stands immovable, drill a small hole through the yoke and the wheel so that you can insert a locking pin when desired. Use catter pin or nail with point cut off to lock

WHEN A DOOR BINDS at top or bottom, you can correct the fit without planing by cutting off portions of one leaf's barrel and inserting washers of same thickness at the opposite end of each barrel section



FOR A SHORT-CUT method of removing the cotton filler from a pill bottle or cigarette lighter, insert the untreated end of a wooden matchstick and rotate it. Rough end of the match snags the cotton.

TO TEST GERMINATION of seeds left over from last year, sprinkle a few on a dampened cotton cloth and roll it up. Store in a warm place for several days and keep damp. If seeds sprout, you can plant them



NOVEL STAND for a flower pot can be made by casting the end of a discarded washing-machine agitator in a base made of concrete. When painted, you'll be surprised at the stand's smart modern appearance



SAFETY RAIL for potted plants placed on the window ledge for an airing or sun bath is just a small dowel inserted through two screweyes driven into the outside of window frame at the height shown



New for Camera Buffs

By Arthur J. Maher

NEW AUTOMATIC 35-MM rangefinder camera, the Contessamat SBE, performed very well in PM tests. It has a sharp f:2.8 Tessar lens and accurate exposure control. Rangefinder sets flash exposures. Camera alone costs \$156. Zeiss, 444 5th Ave., N.Y. 18, N.Y.



BUDGET ZOOM LENS, for 35-mm single-lens reflexes, lists at \$130. We tried it out, found it gives good sharpness. Focal length range is 90 to 190-mm; f-stops, 5.8 to 22. For Praktica-mount cameras. Yashica, 50-17 Queens Boulevard, Woodside 77, N.Y.

8-MM MOVIE FILM SPLICER dispenses splicing tape from a reel, which eliminates the need for a backing on the adhesive surface. Also, mechanism permits making the splice without having to turn the film over. \$4.95 from Du Page Prods., Box 295, Lombard, Ill.



PHOTO HINTS

Projector Stand from Tripod

To make the conversion, cut a piece of $\frac{3}{4}$ -in. plywood big enough to hold your projector and slide file. Fasten a piece of $\frac{1}{4}$ -in. metal to the underside and drill and tap for a $\frac{1}{4}$ -20 screw at the point of balance between the projector and file.



Goodbye to Focusing Cloth

If you use a view camera and are tired of wrestling with a focusing cloth, wrap the transparent barrel of your focusing magnifier with black electrician's tape—preferably the plastic variety. This will prevent extraneous light from getting between your eye and the ground glass, making a focusing cloth unnecessary.





VERSATILE FLASH BRACKET, which also serves as a camera grip, has a ball joint under the flash clip that permits tilting the flash in any direction. Saves you the trouble of hand-holding flash for bounce lighting. Named Accu-Grip, it costs \$4.95. Accura Ltd., 708 Byron Ave., Franklin Sq., Long Island, N.Y.

BETTER 35-MM SNAPSHOTS is the title of a recently updated booklet that includes material ranging from flash technique and basic exposure settings to scene composition. Contains a section on use of automatic cameras and manual over-ride of lens settings via built-in meters. Costs 50¢. Kodak, Rochester 4, N.Y.



PORTABLE MOVIE LIGHT—called the Ultrablitz-Bauer Cine-Jet—is powered by a rechargeable battery that you carry on a shoulder strap. Said to give 10 minutes' shooting time per charge. Price \$70. Allied Impex Corp., 300 Park Ave. South, New York 10, N.Y.

Make Sure You Sync

One method of testing flash sync is to fire a flashbulb through the back of the camera while looking through the wide open lens. If you see a full circle of light, the camera is properly synced. An alternate method that's easier on your eyes is to view the light through a shaving mirror placed in front of the lens as shown.



C-Clamps Ease the Pain

Once a photoflood has been on for a while, the reflector is too hot to touch with your bare fingers. This makes it difficult to adjust the direction of the beam and therefore often results in improper lighting on the subject. Solution: put a pair of C-clamps on the reflector, one on each side as shown, to serve as handles.



TRASH CAN HIDE-A-WAY



By Steve Ellingson

THIS NEAT LOOKING bin not only keeps two trash cans out of sight but also offers a dry place for storage of firewood.

The base frame is assembled first; then the sides, back, doors, top and lid are cut from three panels of $\frac{1}{2}$ -in. exterior plywood. The leftovers are for the floor.

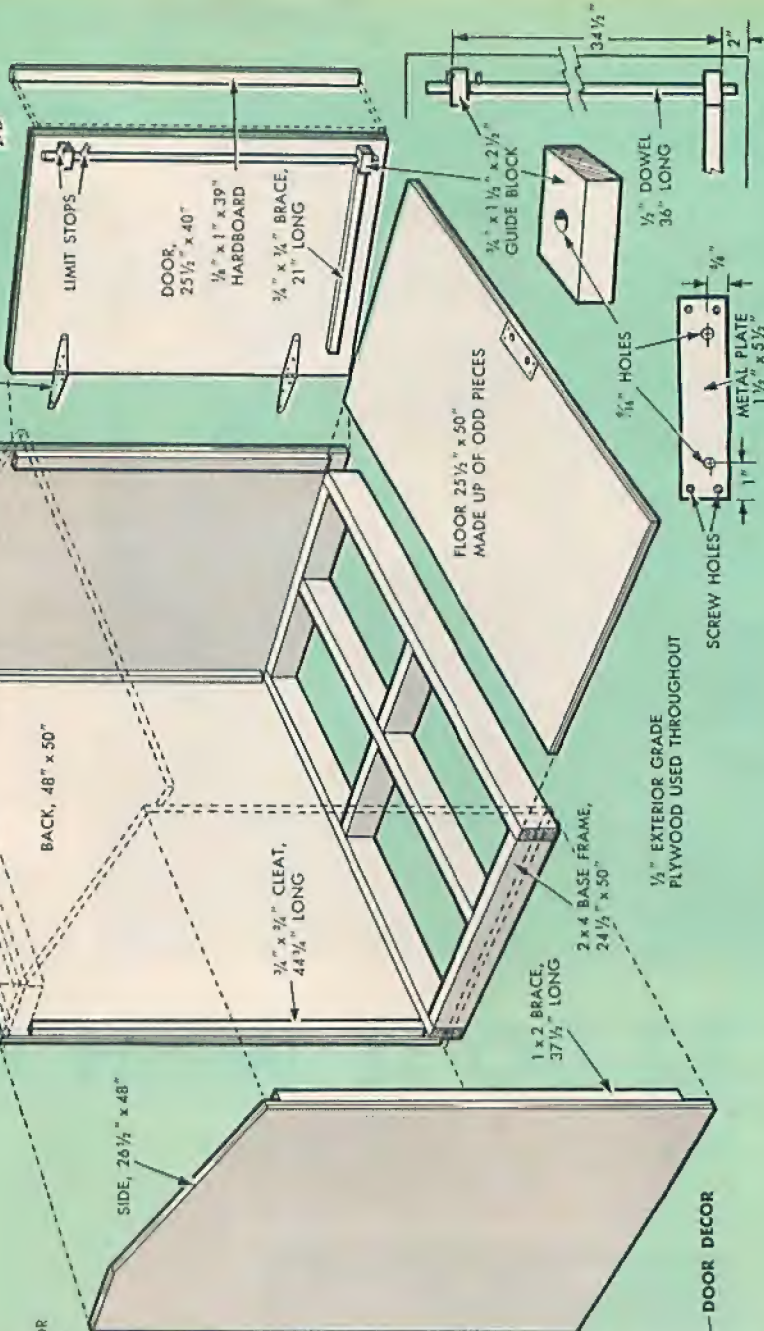
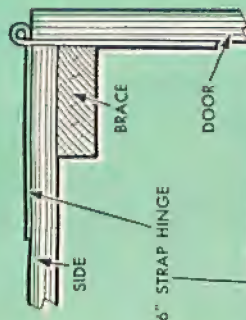
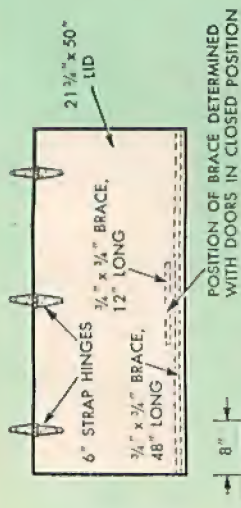
The bin is assembled with flathead wood screws and waterproof glue. Additional strength is provided by corner cleats installed with screws after the floor is in.

The doors are held closed by a sliding dowel. Its travel is limited by pegs that



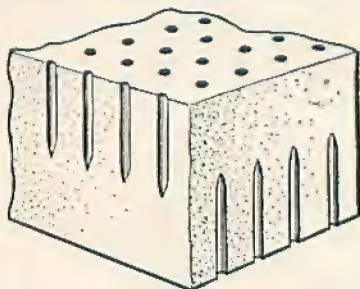
are glued into holes drilled in the dowel. Strap hinges are used to join the doors to the sides of the bin, as well as for attaching the lid. Chamfering the hinged edge of the lid assures proper closing and minimizes strain on the hinges.

A decorative touch may be added to the door by jig-sawing the pig cutout from $\frac{1}{8}$ -in. hardboard. A full-size pattern for the pig cutout is included in a large-size plan (#340) available for \$1 from Steve Ellingson, Popular Mechanics Pattern Dept., P.O. Box 2383, Van Nuys, Calif.





SAGGING SEAT but a sound frame made this chair a perfect project for rejuvenating with foam. The beautiful result is shown at left



GREATER FIRMNESS of new foam rubber results from the staggered pattern of many small holes running in from both sides of the slab

RE-DO IT WITH FOAM

WEBBING STRETCHER makes it possible for you to put leverage on the webbing in order to pull it taut across the frame before nailing. This inexpensive special-purpose tool is almost a "must" for the job



THOSE tricky reupholstering jobs you've shied away from now surrender meekly to modern do-it-yourself materials and techniques. By using a new form of latex foam rubber, you can avoid the complicated and time-consuming chore of tying and replacing loose and broken springs. What's more, foam eliminates the fuss of cotton padding.

Instead of the large core holes found in the underside of foam rubber when it was first introduced, this new kind, which the industry calls pincore, has hundreds of tiny holes, top and bottom. These pass only halfway through the slab in a staggered pattern so they do not meet. This now makes the rubber pad fully reversible and provides a firmer foundation.

The photos on this and the following two pages take you through the steps of reupholstering a chair the easy way.



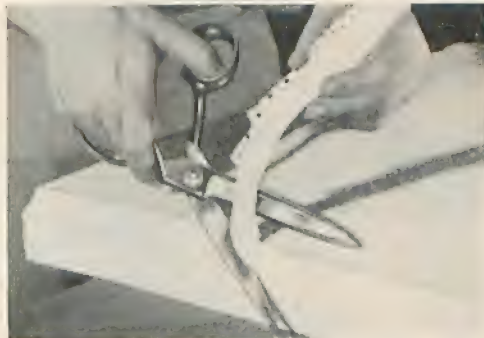
MAKE A PATTERN of the chair seat from wrapping paper so that you will have something to use as a guide when cutting the foam rubber to size. This is especially useful if the cushion has a curved outline



TRACE OUTLINE of the cushion on a piece of 2-in. pincore latex foam rubber, using a felt-nib marking pen. Be sure to allow an extra half inch of foam rubber beyond the pattern as upholstery allowance



REGULAR SCISSORS will cut the 2-in. latex foam with ease. However, if you're working with foam more than 3 in. thick, it's best to cut it with a band-saw. Many upholstery shops will cut cushions to size



WHEN EDGE of the cushion is to be rounded, under-cut it slightly with scissors, as shown. This will make it easier for you to pull the edge down and tuck it under when you are installing the cushion

STRIPS OF MUSLIN cemented along the top edges of the cushion will be tacked to the frame. These strips serve a dual purpose—they not only hold the foam rubber cushion in place but help give it its shape

APPLY TWO COATS of rubber cement to the edges of both the cushion and the muslin, allowing the first coat to become practically dry before applying the second. When this gets tacky, press the two together

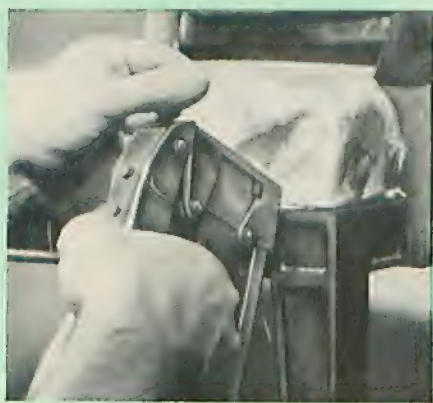




IF CUSHION HAS a curved edge, cut V-shaped notches in the muslin as you apply it so that the cloth will lie flat on the cushion. The width of these notches will depend on the sharpness of the curve



AFTER POSITIONING the latex foam cushion over the jute webbing, you are ready to tack the muslin strips to the chair frame. Be sure that the rubber cement is thoroughly dry before you begin this tacking



MAKING CORNERS with the upholstery fabric may look difficult, but it's actually quite simple if you try this easy method. Pull the material around the corner, lift up excess fabric, staple the fabric that is flat against the frame and drop remaining cloth straight down. Remove excess, leaving only enough material to fold underneath as shown below, then staple or tack the fabric to frame



PULL DOWN on the muslin, then tack or staple it to the frame. The cushion shown here was given only a slight rounded edge; by pulling down harder and tucking foam rubber under, curve can be increased

FINAL STEP is adding a decorative gimp to cover the fabric staples. You'll find it easier to apply the gimp if you glue it on instead of tacking with gimp nails. Run a bead of glue on back, then press in place



Moving Target Helps Sharpen the Eye

POPPING AWAY at a stationary paper target is a lot of fun, but it does little to increase your chances of scoring when hunting season finally rolls around. What you really need to sharpen your shooting eye is something that simulates actual hunting conditions. The moving target shown here does this to perfection.

If you can find about 25 yards of shooting room protected by a suitable backstop embankment, you're all set. Drive two 2 x 4s or 2 x 2s in front of the backstop; the target is suspended from a wire strung between these stakes and held taut by a coil spring. The stakes should be at least 25 feet apart. Back at the firing line, drive a third stake. Two inexpensive, level-wind bait casting reels are taped to this stake to "power" the target.

Both target stakes are fitted with a line guide such as is used on a spinning rod, though a simple screw eye may be used.

Hitting the target can be made as easy or as difficult as desired. For example, uneven operation of the reel handles will cause the target to bounce like a rabbit. A small kink in the wire makes the target jump wildly.

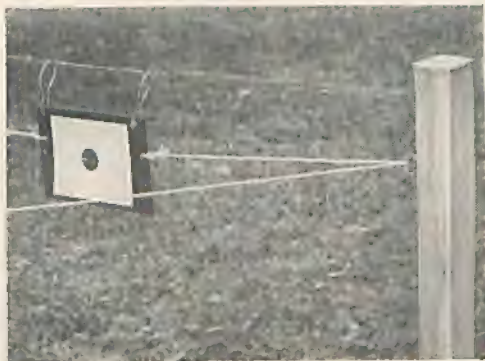
For economy, it's best to practice with a .22, rounding off with an occasional big-game rifle session.—Charles Waterman



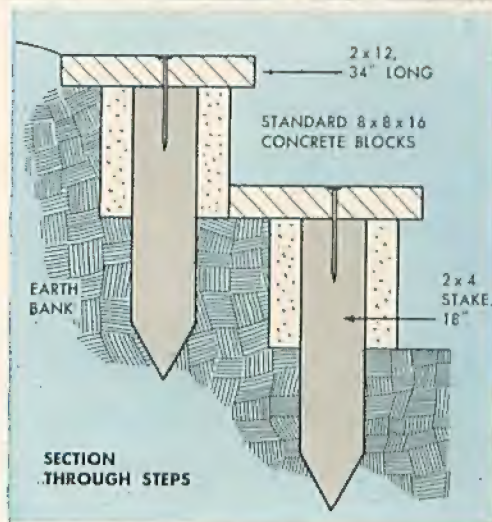
CRANKING THE HANDLE of one fishing reel moves the target from left to right at any desired speed. The other reel reverses direction



THE TARGET is suspended on shower curtain rings that ride along fishing leader wire strung between posts. Spring holds the wire taut



Block Steps for Steep Slopes Are Staked in Place



A neat, long-lasting stairway leading from your yard to a lower level, such as a boat landing or terrace, can be built in a few hours with concrete blocks.

Begin by cutting 2 x 12 in. redwood lumber into 34 in. lengths, one for each step. After that, saw a 2 x 4 into 18 in. pieces, pointing the ends for use as stakes. A liberal application of a wood preservative to the stakes and steps a couple of days before installation will ward off decay.

After clearing the area of roots and stones, place two concrete blocks, core side upward, to form the bottom step. Make sure the soil is firmly tamped down to prevent settling, then drive a 2 x 4 stake into the center core of each block. Fill in the cores with dirt and continue building the other steps in the same way. Then spike the 2x12 treads into the ends of the stakes.—J. Kelso

Lamp Shelf Keeps Drafting Table Neat and Orderly



This handy shelf made from $\frac{3}{4}$ in. plywood or solid stock keeps the drafting table free of clutter and minimizes the danger of spilling ink or paint on nearly completed artwork, as often happens when all materials are kept on the drawing board. The unit is simply a shelf bracketed to a backboard which is in turn fastened with screws to the drafting table. An opening cut in the backboard provides a convenient place to attach a lamp. Shelf can be varied to suit your needs.—A. Weber

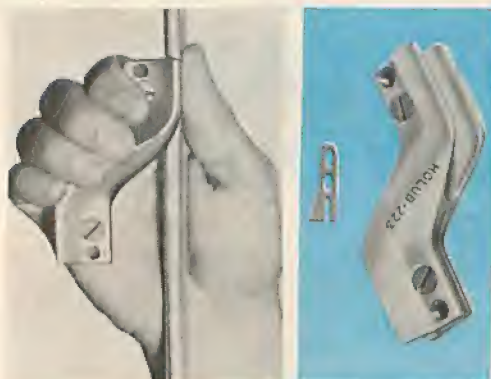
Chuck a 2-in. length of fine-toothed rat-tail file in your electric drill and you have a perfect tool for enlarging small holes in sheet metal or reaming an irregular opening to shape.

Shopping for Tools



VERSATILE LEVEL is magnetized on bottom and two sides to hold it on any ferrous metal. Leaves both hands free. Movable vial head swivels to left or right, gives direct reading of angle of slope. The unit measures 1¾ by 2½ in. and sells for \$2.50. Vaco Prods. Co., 317 E. Ontario St., Chicago, Ill.

ROM-A-RIP CABLE RIPPER slits braided or plastic insulation. You press the cable into a groove with your thumb as you pull the ripper along. A tiny adjustable blade does the cutting. Two sizes cover the full range of cable from No. 14 NM through No. 2 SEU. \$1.95 each from Holub Industries, Inc., Sycamore, Ill.



DISPOSABLE PAINT APPLICATOR is made of foamed plastic that can be cut into any shape desired to simplify tight work. It applies paint and varnish smoothly and, of course, eliminates loose bristles and clean-up. In 2-in. to 5-in. sizes, from 29¢. Hyde Mfg. Co., Eastford Rd. & Clemence St., Southbridge, Mass.



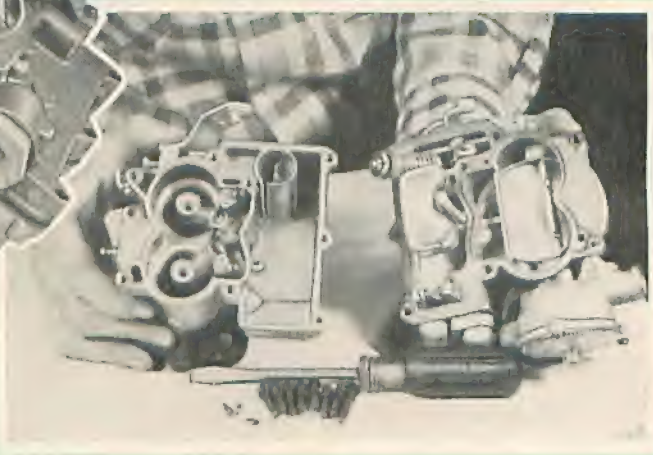
NO MORE FUMBLING FOR MATCHES when you use the Model LP2655 Pivot Pilot Torch. It's a propane burner with flint lighter permanently attached. You ignite the gas by turning a wheel. Lighter folds out of the way when burner is in use. Retail price is \$8.49. Turner Corporation, 821 Park Avenue, Sycamore, Ill.



HEAVY-DUTY PIPE WRENCHES no longer take a wrestler to lift 'em. New ones, made of forged aluminum, are about 66 percent lighter than steel wrenches. Available in 10- to 48-in. sizes with steel or spark-proof beryllium copper jaws. Priced at \$4.80 and up. Schick Products, 591 Quarry Rd., Box 867, Belmont, Cal.



Conclusion



SHOULD YOU LAY A HAND ON YOUR CARBURETOR?

By Morton J. Schultz

HOW DO YOU KNOW when your carburetor needs work?

Every mechanic, from the specialized training-school type who deals with cars for a living to the home-grown weekend tinkerer, has his own answer to this question.

Some are guided by what their speedometers say—"it's racked up another 5000 miles, so a carburetor job is needed." Others by the way in which the car acts—"it's flooding, so let's take the carburetor off and overhaul it." And some, if you pressed them, would have to admit that they "decide" on the flip of a coin.

The truth is you're never really sure a carburetor needs tuneup. Everything may point to a carburetor-caused condition, but there may have been that little something you overlooked in another part of the car which is the real cause of the trouble.

Don't misunderstand: We're not claiming that carburetors seldom go bad. As we learned in Part I of this article last month,

faulty carburetors are high on the list of trouble-causers. A defective carb can mean hard starting and flooding; rough running and surging; flat spots, hesitation and balks in acceleration; poor gas mileage; backfiring; fouled spark plugs; rough idling; and stalling.

But any one of these malfunctions could be brought about by one or a number of conditions other than a bad carburetor. Which is why you do a carburetor overhaul last. Don't make your carburetor a scapegoat for every malfunction that occurs.

But let's assume you've more or less isolated your trouble at the carburetor. How do you go about curing the suspected carburetor trouble? The approach can be summed up in three words—*clean, replace, adjust!* One should never be done unless the others are done.

It's foolish, for example, to adjust a dirty carburetor—your adjustments can't be accurate. It's just as foolish to clean a

carburetor and not adjust it. And who would clean and adjust a carburetor and leave worn parts in it?

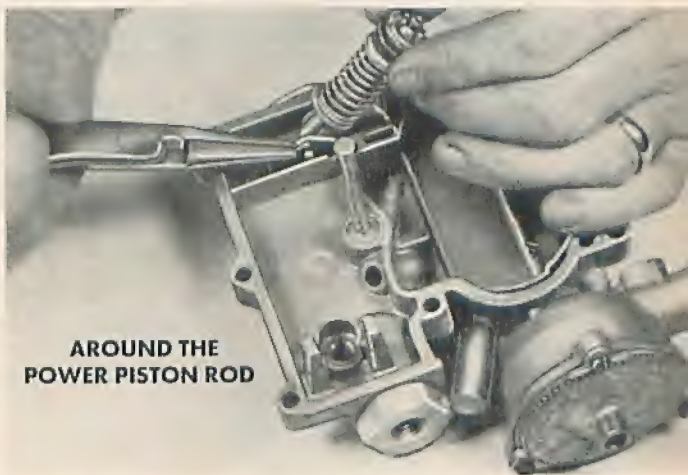
To describe specifically how to do these jobs for each different carburetor is not possible in this article. Breakdown, parts replacement and cleaning procedures are fairly similar from carburetor to carburetor, true, although one type could possess a part or parts that another doesn't. But adjustment procedures and specifications may vary widely.

Our purpose, then, is to take a typical carburetor—the Rochester two-barrel job found on many General Motors cars—and explain the overhaul operations for it, to show that the job isn't as tough as it seems. Given a step-by-step procedure to follow, anyone with some technical know-how can tune up their own carburetor.

All the same, it might be safer to first try your hand on a unit other than the one on your car. Get an old carburetor from a junkyard or a mechanic friend, (preferably the same model as your own) and rip it apart. Then, if you make mistakes, it won't be drastic.

Before you start, it's a good idea to have a service or tuneup manual for your specific model carburetor. You may be able to find such a manual in the local library, or borrow one from your service station. You can also write the manufacturer of your carburetor for details, giving the model number of your unit, which you'll find stamped into the casing or on a nameplate. But before you go to a lot of trouble, buy a carburetor tuneup kit for your carburetor. It may include all the adjustment specifications you need.

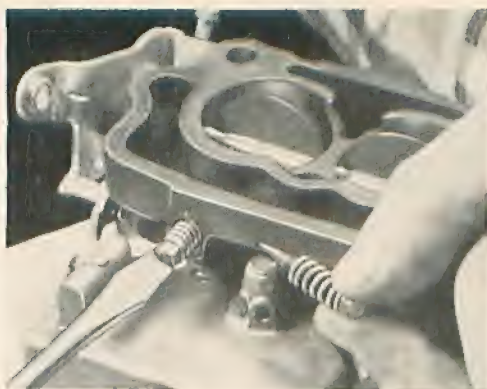
Simple tuneup kits for one- and two-barrel carburetors cost about \$4.50. Those for a four-barrel unit cost about \$6.50.



**AROUND THE
POWER PISTON ROD**

TWO-BARREL CARB splits in two (facing page). Start work on parts of bowl assembly grouped near rod. Disconnect float by removing hinge pin (top left, above), then remove and discard bowl gasket and needle valve beneath float (top right). Unscrew the slotted needle valve seat (center left) and discard it and the filter screen beneath it. Test the piston rod by pressing it down (center right); if it's binding, replace it. Finally remove and discard the accelerator pump plunger (directly above). Now turn your attention to the air horn section: remove the pump plunger spring (below left), unscrew the venturi cluster (center) and remove the tiny T-shaped retainer, beneath it (right). This opens pump discharge circuit so you can remove the spring and ball or needle





UNSCREW THROTTLE valve assembly from air horn and remove idle mixture screws to inspect their threads. If stripped or corroded, replace with new

If your carburetor is fairly new and you've cleaned it periodically by the force-flow method described last month, you can forget off-the-car cleaning and just make adjustments.

However, if it has not been removed, cleaned and adjusted in, say 30,000 miles, it should get the full treatment now despite frequent force-flow cleaning. The force-flow procedure, although it does a good job of keeping the unit relatively clean, does not let fluid work its way into all crevices and passages. Eventually, these may get clogged.

The repair kit you buy will contain the parts needed for simple tuneup, including those items that wear most frequently, such as the needle-valve assembly, accelerator pump plunger and all gaskets. It's wise to replace all these items while you have your carb torn down. But always check your repair kit before discarding any parts during disassembly to make sure

replacements are provided.

If other parts not contained in the repair kit are needed, such as jets, venturi cluster or idle mixture screws, they can be bought separately. Or, if you wish to do a complete overhaul, all parts can be purchased in kit form by asking for an overhaul kit for your carburetor. These cost about double the price of a simple tuneup package.

Included in most tuneup kits is a combination gauge for adjusting float drop and level, and accelerator pump height. If your kit doesn't have this, you can buy separate gauges for a few cents from your auto-parts dealer. Just make sure you get the ones specifically needed for your model carburetor.

After disassembling the unit as shown in the photos on page 159, test the float for leaks by putting it in a pan of water for a few minutes. Then shake it near your ear. If you hear water sloshing inside, the float is defective and a new one is needed. The other checks are covered in the captions. In some carburetors, there are one or two metal checkballs beneath the pump plunger coil spring. You can shake these out by inverting the assembly and rapping it in the palm of your hand. They're small, so take care not to lose them.

The power piston valve is the large one between the two jets. Remove it and test it by pressing the plunger in the valve's center. If this binds, get a new valve. Then, remove the jets and examine their threads. If stripped, get new jets, but never change their size since it'll upset carburetor balance.

Take all the parts you've removed, and the casings, and immerse them in carburetor cleaning solvent. To simplify cleaning, fashion a wire basket to fit into the

REMOVE CHOKE COVER and gasket; gasket will be replaced, but lay cover aside (lower left) to remind you not to immerse it in cleaning solvent (because of its thermostatic spring). Next remove slotted cover inside to get at choke piston. With carb shown, you must slide assembly off to get piston from its shell



ADJUSTING THE CHOKE



ADJUSTING THE FLOAT



ALL FLOAT ADJUSTMENTS must be precise, so secure a gauge made for your carb. Deviations from specs could cause either flooding or fuel starvation. The two pairs of photos below show how to check and correct float for both level and drop



TO CHECK LEVEL (above left) place gauge so it rests on bowl gasket, just touching float. For float shown, adjustment is right when you align seam with mark on gauge, by bending hinge (top right). For drop adjustment, hold bowl so float hangs (right); top of float should align with a mark on gauge. If adjustment is needed, bend tang toward float to raise level, away to lower



receptacle holding the solvent. Let the parts stay in the cleaner for several hours. Agitate frequently (say, once every half hour) to make sure the fluid penetrates all passages and crevices.

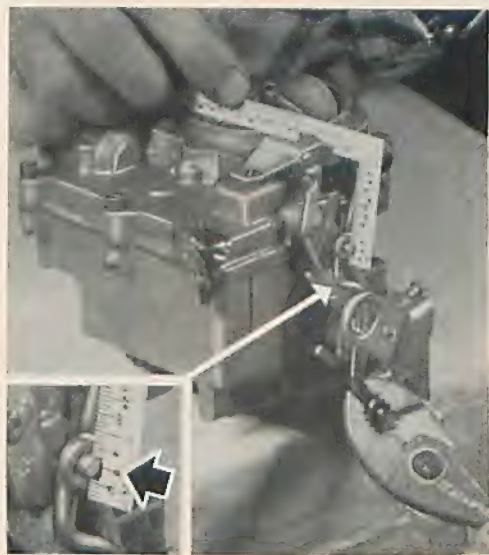
After cleaning, blow out parts and casings with compressed air. This serves two purposes: to hasten drying and to dislodge all loosened dirt inside the passages.

If you lack access to compressed air, perhaps your local service station will let you use theirs. If not, forget about cleaning your own carburetor and let a specialist do it. There's no sense loosening carburetor dirt only to have it sit there and harden again.

Whatever you do, never stick wire down into passages in an attempt to get dirt out, since you could scratch the finely calibrated surfaces. And never wipe parts or the inside of casings with a rag. Lint and threads could stick to them and eventually cause obstructions.

There are five adjustments to be made on *any* carburetor and these are the ones shown in the photos on these two pages: choke, float, accelerator pump, idle speed, and idle mixture. (Some carburetors re-

ADJUSTING THE ACCELERATOR PUMP also takes a precise gauge. Turn carb over to see that throttle valves are fully closed. If not, close by backing off idle screw from fast idle cam. Bend pump rod until tang is centered on proper calibration (arrow)





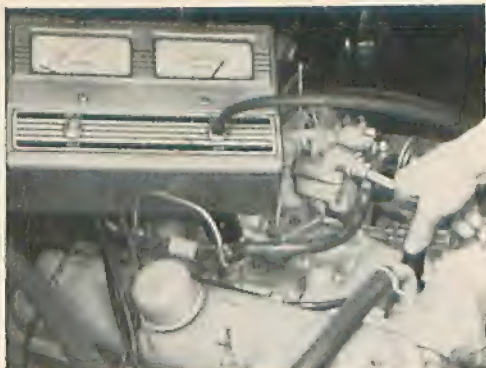
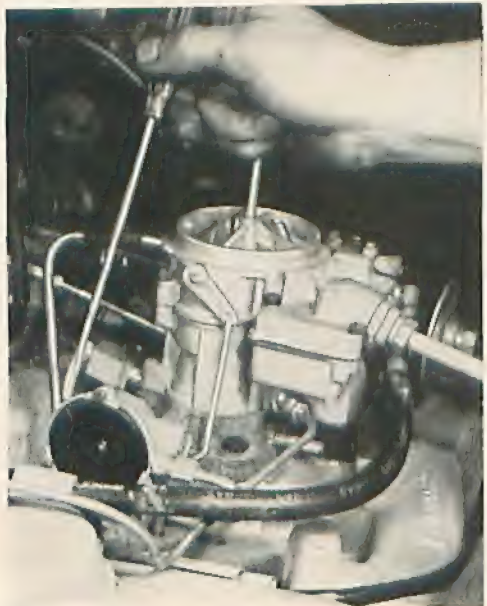
ADJUST IDLE SPEED by hooking up tachometer, after warming engine. With screwdriver, turn adjustment screw in or out till gauge shows recommended r.p.m.

quire additional adjustments, discussed at the end of this article).

After your carburetor is clean, reassemble it (simply reversing the order of disassembly), installing new parts from your repair kit as you proceed. Before attaching the air horn to the bowl, you should adjust the float for level and for drop, as shown on page 161. Then, complete the assembly of the carburetor, but before putting it back on the car perform the accelerator pump adjustment (same page). What you're actually doing is adjusting the length of the accelerator pump stroke.

The accelerator pump is supposed to deliver an exact amount of fuel into the air stream. If too much gas is injected, a

AUTOMATIC CHOKES need correct positioning of the notched cover with indicator on choke housing. On some units, adjustments differ with time of year



NEXT, IDLE MIXTURE is adjusted for smoothness. With vacuum gauge, screw (or screws) can be positioned precisely where engine vacuum is greatest

rich mixture results, leading to flooding and poor gas mileage. If too little fuel is delivered, the result is delayed acceleration and a prolonged period before the car reaches the desired speed.

Your other adjustments are made with the carburetor back on the car. When you hook up a tachometer for the idle-speed test, above left, make sure the fast idle screw is *off* the high step of the fast idle cam if the car's equipped with automatic transmission. You'll find that cars equipped with automatic transmission idle slower than those equipped with a stick shift. This is to prevent "creep" while the car idles in gear.

Single-barrel carburetors have a single adjustment screw for idle mixture. Two-barrel carburetors have two. Four-barrel units also have two screws because only two barrels—usually the first two—contain the idle system. The rear two barrels of most four-barrel units are for high speed performance only.

When the idle mixture adjusting screws have been correctly positioned for smoothest idle and highest engine vacuum, go back and check idle speed once more with a tachometer. You will probably note that idle speed has picked up considerably. Re-adjust idle speed to bring it within specifications again. Now, go back and readjust the idle mixture, and keep adjusting speed and mixture alternately until the two are properly tuned.

Manual chokes require only a positioning of the cable to make sure the choke plate is closed in the carburetor throat when the choke button is pulled out inside the car. When the button is pushed in, the choke should open.

To adjust this, have someone hold the choke button in. Loosen the screw on the clamp that holds the cable-to-carburetor bracket. Position the choke plate straight

(Please turn to page 194)

AUTO CLINIC

Q My 1961 Rambler recently developed loss of power and heavy missing. The cause was traced to four burned valves and four warped valves. I've had the damage corrected, but can you tell me how to prevent it in the future—or is this just impossible to do with an aluminum engine?—L. C. K., Fla.

A The most important thing you can do is make sure the head of that engine is never overtightened. The torque on aluminum engine heads is critical. It should be 50 to 53 pounds—no more, no less. Also make sure you keep your engine oil clean. And, if you do much slow speed driving, use a tankful of high test gas every so often to clean the engine out. Slow speed driving is tough on any engine, but particularly on aluminum types. The grit and dirt built up inside that engine could cause valves to burn and warp.

Q I have a temperamental 1960 Oldsmobile F-85 that cuts out as soon as I start it. Yet, once I get it started it runs fine. What's going on?—J. W. D., Penna.

A Your problem may be familiar to other owners of '60-'63 Olds. It's caused by a weak resistor on the coil that makes the points oxidize and blue, leading to the stop-when-started condition you describe. This resistor generally crystallizes and gets hard after 18,000 to 20,000 miles of driving. Oldsmobile has come out with a new resistor to overcome this. It's part number 384981, and your Olds dealer should have it.

Q My 1960 Comet smokes excessively through the engine breather pipe, but the car doesn't burn oil. What's your analysis?—L. G. R., New York

A Comet owners take heed. It could happen to you, too, after several thousand miles. The probable cause is valve guide seals that get mushy and permit smoke to pour out of the engine through the breather. There's only one solution: new seals.

Q I hear a whistling from my engine when I drive my 1960 Ford at speeds below 50 miles an hour. When I open the hood, no bird flies out, so what can it be?—K. F., South Dakota

A Chances are that you'll find your "bird" in the carburetor, being caused by a vacuum leak. The chief reasons for this are a carburetor that's not bolted down tight enough or a bad carburetor center gasket. The first thing to do is tighten all carburetor mounting bolts and assembly screws. If the bird-whistle persists, you'll have to replace the gasket.

Q Please tell me why my 1962 Chevy Biscayne with automatic transmission stalls suddenly when I stop at a stop sign, red-light or what have you. The engine starts right up again without trouble. Any hunches?—E. R. L., Mo.

A My crystal ball tells me that your stalling problem results from the absence of a dashpot in the carburetor. Most cars equipped with an automatic transmission have this unit, which slows the engine down gradually when the accelerator pedal is suddenly released, as described in this month's Saturday Mechanic. For some reason the Biscayne doesn't have one. But before you invest in a dashpot, have the float level in the carburetor set a bit lower. This will keep a surge of gas from flowing into the carburetor when you stop suddenly. It's this surge that floods and stalls the engine when there's no dashpot. If lowering the float level doesn't do any good, then you should investigate the installation of a dashpot.

Monthly Service Tips

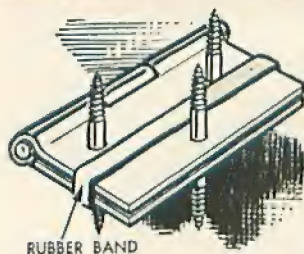
★ If your 1964 six-cylinder Dodge equipped with a Carter carburetor is flooding out, making it hard to start, check the position of the choke setting. The original setting was for four notches rich. There is now a new setting recommended by Dodge. It's for two notches rich, so back 'er off.

★ If you're bothered by a wiring harness interfering with the left hood hinge of your 1963 Comet, take heart—and take the car back to your Mercury dealer. The wire harness retaining strap was inadvertently left off. He'll put a new one on to hold the harness—part number 372368-S.

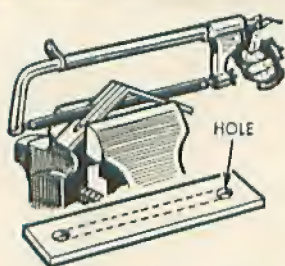
At Your Service

Although only questions of broad general interest can be answered in print, we don't ignore the private, special problem. If your car is acting up, your inquiry will bring an individual reply—a free diagnosis—whether we print your letter or not. Address Auto Clinic, Popular Mechanics Magazine, 575 Lexington Ave., New York 22, New York.

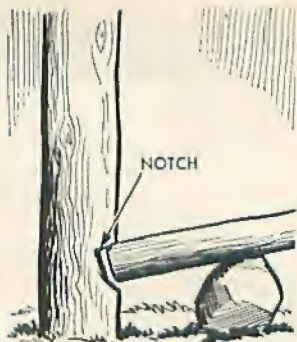
TAKE A HINT FROM READERS



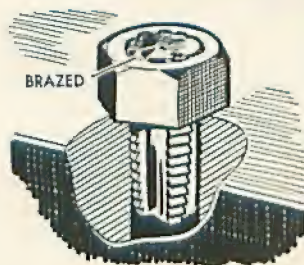
TO AVOID misplacing hinge screws, store them right with the hinges. Just slip the screws into the screw holes, fold the leaves together so they can't slip out and stretch a rubber band around the folded hinge to secure it during storage



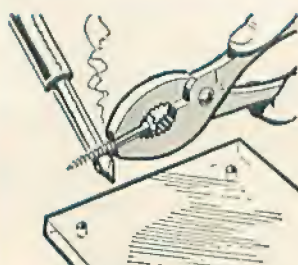
HOW CAN YOU cut a blind slot through a metal plate with a hacksaw? First drill a hole at each end of the slot, then bend the metal at a sharp angle. Clamp the work in a vise and saw from hole to hole. Finish by flattening the plate again



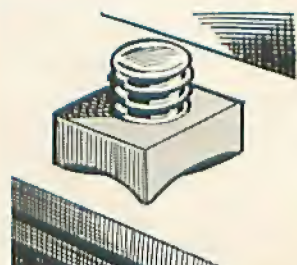
ONE OF THE simplest methods of loosening old fence posts for removal involves cutting a notch in the lower part of each post to accommodate the end of a pole used as a lever. A stone or block of wood makes an efficient fulcrum for the pole



WHEN YOU BREAK off a top in a piece of work and find that the usual methods of removing it won't work, try brazing a nut to the stub. This will enable you to grip the nut with a wrench and turn the top out without damaging the work in process

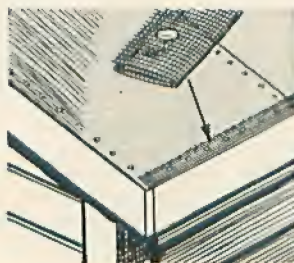


TO TAP HOLES in plastic, just drill them slightly undersize, then heat the threaded portion of a screw with a soldering iron or over an open flame and turn the screw into the hole. The hot screw will do a neat job of cutting threads in plastic

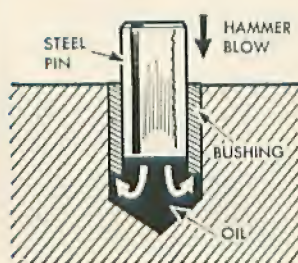


WHEN YOU CAN'T use a lock washer but want the nut to be vibration proof, convert it to a lock nut by filing cross flutes on the underface with a rat-tail file. This leaves spike-like corners to dig into the work as the bolt is turned to draw it snug

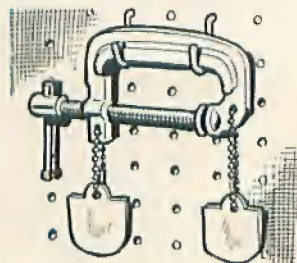
USE FOLDED STRIPS of screening to anchor the edges of tarpaper roofing along the eaves. When tacked in place as shown, the screening will prevent the roofing from being pulled loose and torn away by a high wind. It's low-cost roofing insurance



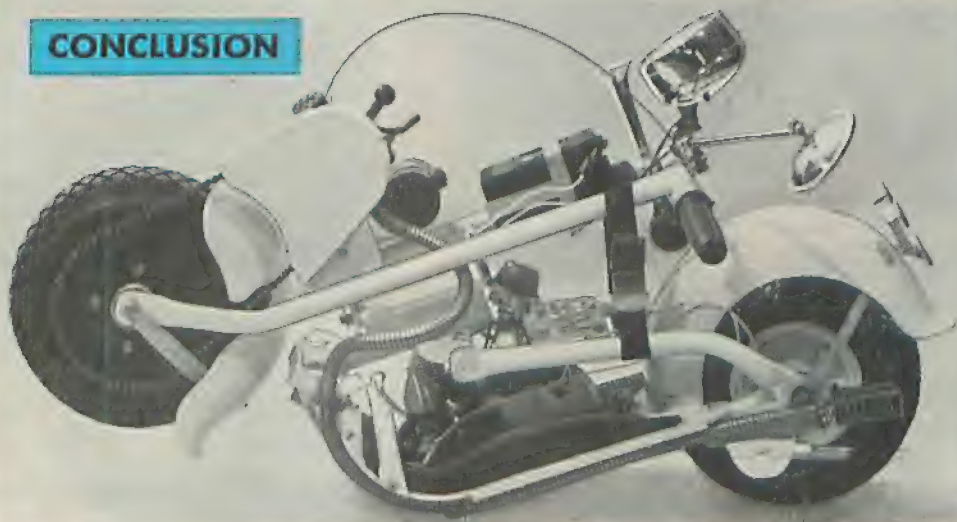
NEXT TIME you find it necessary to remove a bushing from a blind hole, fill the hole with oil to about 1/2 in. above the bottom edge of the bushing and insert a steel pin which is a sliding fit. When pin is struck with hammer, bushing is forced out



TO KEEP JAW PADS handy for use with your C-clamps, simply drill a pair of holes in each clamp and hang a leather disk from each hole with a short length of ball-type chain. For longer wear, add a grommet to protect the hole in leather pad



CONCLUSION



the SCOOTER that HITCHES a RIDE

By Manly Banister

IF YOU'VE HAD a month's use out of the motor scooter we presented in our April issue, you may already have been ticketed for operating an unlicensed vehicle. Why? Well, it's unlikely anybody'd issue a license on the naked frame assembly we left you with last month. So, in this second half of the article, we hasten to detail the vital accessories you need to complete your collapsible *Tom Thumb*.

Once you've welded on the flanges of modified angle iron that support the aluminum floor plate, you're ready to make a pair of fenders. The cheapest method would doubtless be to cut two strips from the same $\frac{1}{16}$ -in. aluminum sheet as the floor plate, and bend these in a sheetmetal former to the proper contour. But if you value style above economy, you'll want to mold the fenders of fiberglass. The technique is simple, materials are widely available, but good instructions are hard to come by. Six different "experts" will render six conflicting opinions, and if you've never handled fiberglass before, you'll wind up in total confusion. That's why we're detailing the process here.

▲ FOLD-UP DESIGN . . .

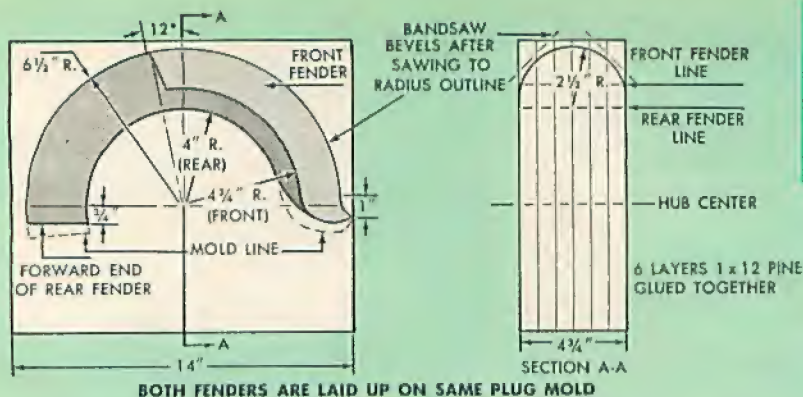
. . . lets seat pivot flat against floorboard while front fender folds back. Strap makes it easy to pick up and swing into back of car

▼ READY TO ROLL . . .

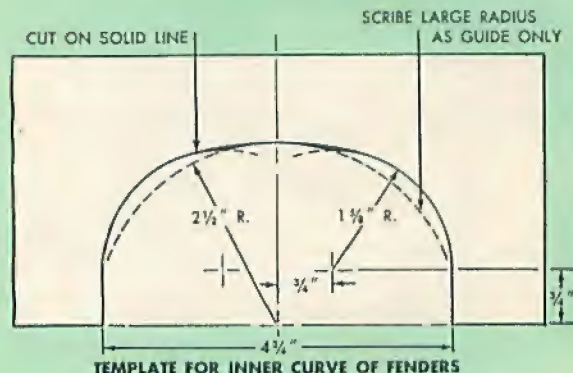
. . . bike is sturdy, despite light weight. To race engine, lift front wheel by handlebars



MOLDING THE FIBERGLAS FENDERS



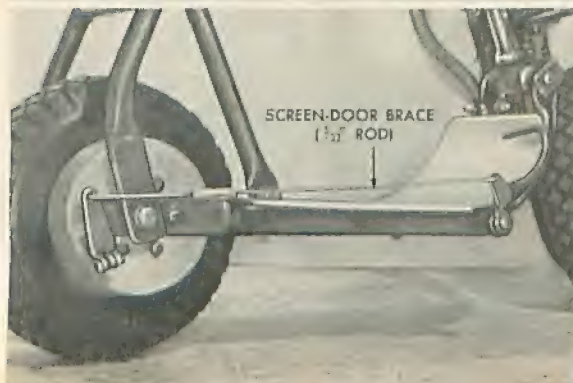
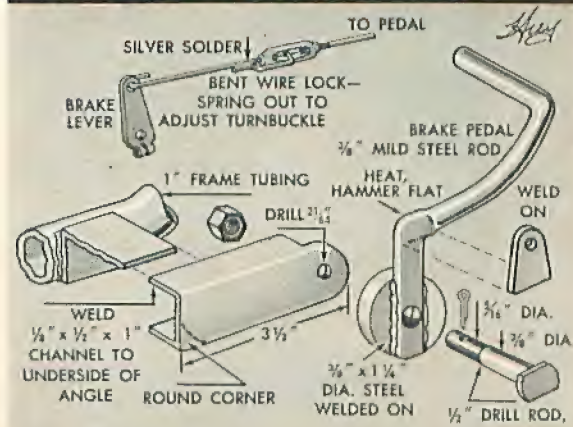
BOTH FENDERS ARE LAID UP ON SAME PLUG MOLD



TEMPLATE FOR INNER CURVE OF FENDERS

SIMPLEST MOLD is lay-on (plug) type, which is shaped to inside contour of fender. As shown in section sketch, six layers of pine (actual thickness $\frac{3}{4}$ in.) glue up into a block about $4\frac{3}{4}$ in. thick. On the top face, lay out the contour of the rear fender and the other reference marks sketched at upper left. Cut a cardboard template to guide you in rounding off the bevels (top right photo, next page). After shaping, fill voids and irregularities with wood filler and sand smooth. Apply two coats of polyester surface coat (or lacquer), sanding both coats smooth. A coat of good paste wax, buffed when dry, readies the mold for the gel coat

BRAKE PEDAL ASSEMBLY



These steps were worked out by trial and error. If you follow them carefully, we'll have made all your mistakes for you.

Collect all materials before you start. The check list, far right, covers everything you'll need for two fenders. In choosing a color pigment, remember that if you want to match the rest of the bike, it's best to use white in the resin and paint the fenders when you paint the frame.

After forming the mold as shown above, prepare it with an application of mold release wax over the entire surface. Buff when it dries, then brush on a coat of liquid mold release and let it dry.

Cut fiberglass cloth and mat into 4 x 10-in. strips, and cut several additional strips only 2 in. wide to turn the rather sharp curve at the flare of the rear fender. Prepare the strips for the rear fender first—enough for two layers of cloth and one of mat. Also cut cloth for a final layer, but make this a 4-in. strip to run along the crown of the mold, plus 2x4-in. pieces to fill in along the edges.



FIRST STEP in cutting mold is to bandsaw top contour. Then tilt table to 45 degrees and slice off corners, keeping the blade parallel to the front-fender inner radius. Note layout on face and waste



FINAL SHAPING converts beveled block into smooth contour, above. It's done with tools shown in foreground (all varieties of Surform), starting with rotary cutter in drill—and ending with sandpaper

ON THE FORM, overlapping fiberglass cloth extends far enough to allow sawing the elliptical inner contour marked from the template layout, far left. Rear fender has been removed from form, below right



Now mix about 2 oz. of laminating resin with the required amount of color paste, add catalyst and stir thoroughly. Brush on several thin coats of the colored resin until the surface of the mold is well hidden. Let this stand until tacky. It's called the gel coat. Be sure to wash brushes and containers in acetone at once.

Measure out 12 oz. of laminating resin and mix in the required amount of catalyst. The catalyzed resin has a "pot life" (the time it stays liquid and usable) of 30 to 40 minutes—ample to complete the entire fender lay-up.

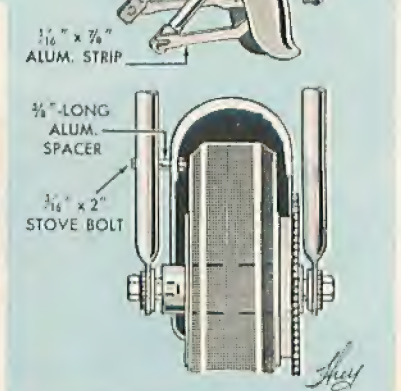
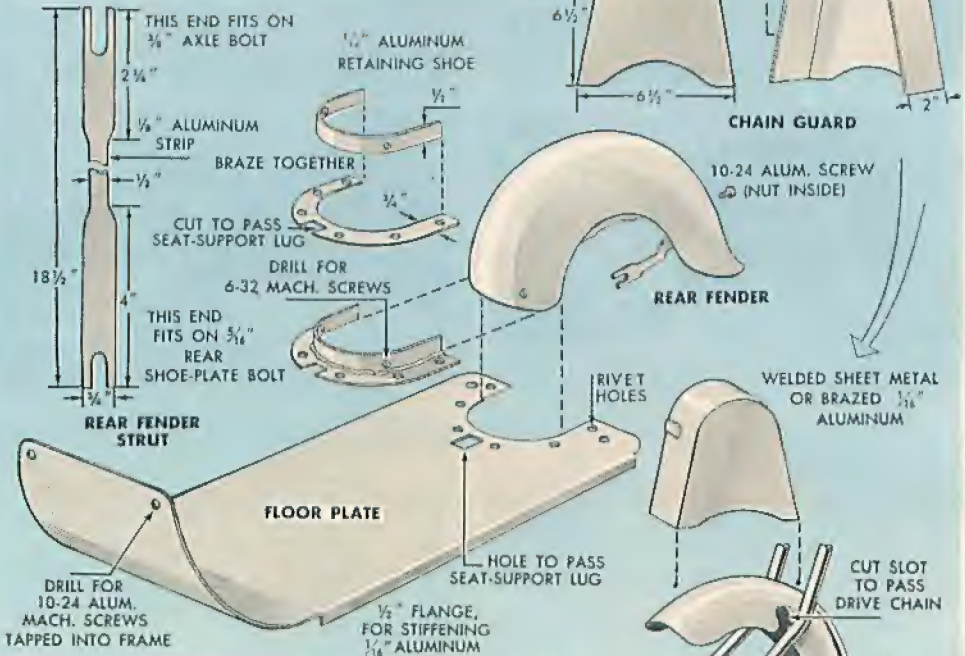
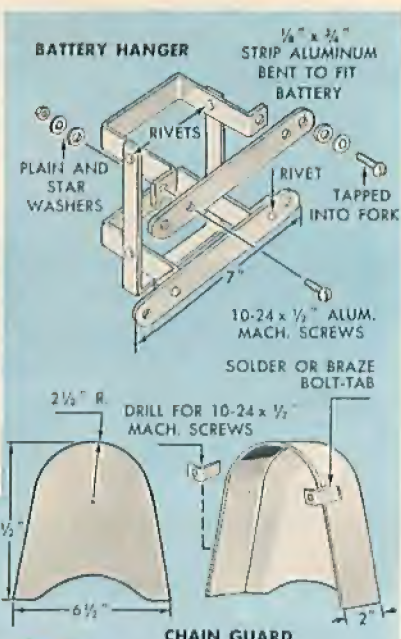
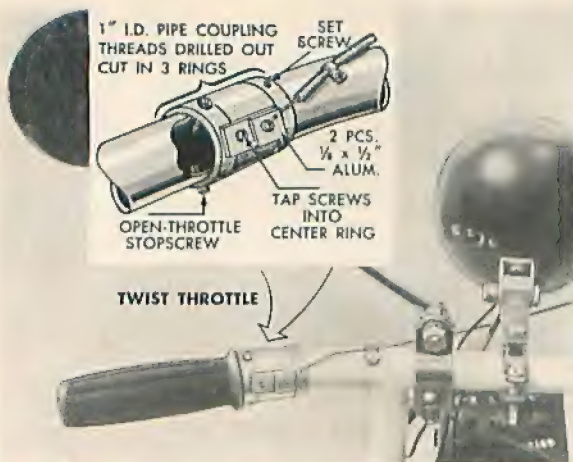
Brush on clean laminating resin, taking care not to brush through the gel coat. Flow it on, like enamel.

Starting at the flared end, lay on the strips of fiberglass cloth, pressing them down in the resin. If you don't want to get caught sticky-fingered, lay a piece of plastic kitchen wrap over the surface and work through it. Apply one piece at a time and saturate it thoroughly with laminating resin, applied with a brush. As you lay on each strip, overlap the first until you've covered the entire mold. If small triangular

MATERIALS CHECK LIST

- ☐ 1 yd. 44-in.-wide fiberglass cloth
- ☐ ½ yd. 44-in.-wide heavy gauge fiberglass mat
- ☐ 3 pints polyester laminating resin (with catalyst)
- ☐ 1 pint polyester coating resin, clear (with catalyst)
- ☐ Jar of white or color of choice, sufficient to pigment quart of resin
- ☐ Small can polyester surface coat (with catalyst)—or clear lacquer
- ☐ Can of mold release wax
- ☐ Bottle of mold release liquid
- ☐ 1 qt. acetone (solvent for cleaning hands, brushes, etc.)
- ☐ Epoxy cement (for filling, smoothing)

Total cost: around \$20, including mold lumber



patches show up on the sides uncovered by cloth, don't try to stretch the cloth to cover. Instead, lay on small, overlapping patches, saturating them with resin.

Don't stop after the first layer's on. Keep going, adding a layer of fiberglass mat in the same manner. This is a thick material without much strength; its purpose is to build up the bulk.

Now lay on the second layer of fiberglass cloth, making sure all areas are covered and that no air bubbles are captured in the lay-up. They're readily visible, so don't worry about them escaping your notice. Just lay on a piece of plastic wrap and work the bubbles out the nearest edge.

Lay on the third and final layer of fiberglass cloth, making certain the weave is well filled with resin. If resin runs down the sides of the molds, brush a little more on top. Soon the polyester will begin to set along the lower edge, retaining the liquid on top.

When the resin in the container starts to thicken, dump it and wash up everything with acetone. Let the lay-up stand until it sets so hard you can't dent it with a thumbnail (2-3 hours in hot, dry weather, or if exposed to a couple of heat lamps). After rasping and sanding smooth, remove the lay-up from the mold. Start by working a chisel under the edges of the laminate. If you've carried the laminate well down over the front curve of the mold, you may have to chisel off about an inch, here. Since the rear-fender lay-up encompasses slightly more than 180 degrees, it must be gently forced from the mold, using a stick and a mallet against the chiseled-off end until it springs out around the curve.

As soon as you've cut the inside contour from the template given, fill all holes, voids and rough spots with epoxy cement and sand again, when dry.

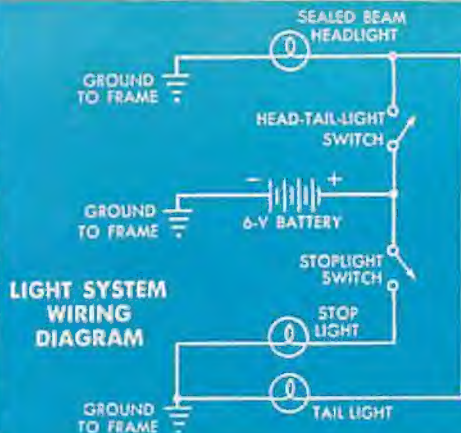
Final trimming—and locating the chain slot—should be done when fitting the fenders to the frame. The rear fender should be bolted to its retaining shoe (sketch, left) and installed as a single unit with the floor plate. When you do the final smoothing, using the disk sander, back the paper up with a rubber pad.

You'll remember that the gel-coat (your first application on the mold) was pigmented *laminating* resin. This resin won't air-cure; the surface remains tacky unless you sand it away to expose the cured material beneath. *Coating* resin, on the other hand, is *made* to cure, on exposure, to a hard, glossy surface. Since the gel-coat has taken care of coloring the inside surface, you need concern yourself now only with the outside.

Mix several ounces of coating resin

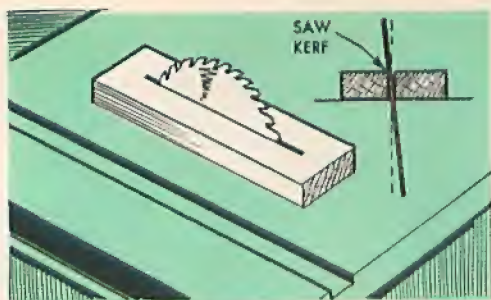
(Please turn to page 185)

BRAKE LIGHT MOUNTING



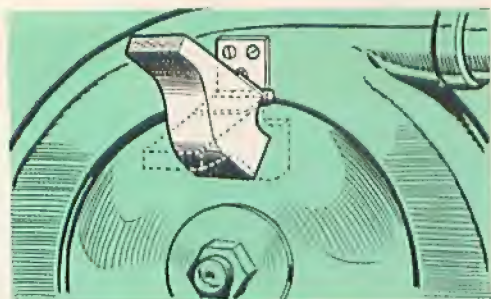
...AND AWAY WE GO!





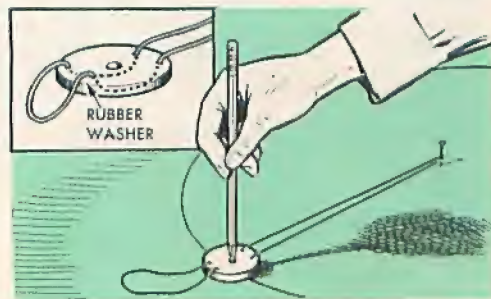
Kerf Clamps Saw Blade

Any man who owns a bench saw with a tilting arbor is likely to have his own favorite way of locking the blade for a touch-up filing job. The method I use is to cut a blind slot in a piece of scrap wood with the blade vertical. To clamp the blade and hold it at any desired point, I simply place the block over the blade and turn the tilt knob to wedge it snugly but not too tightly, in the slot.—G. E. Hendrickson



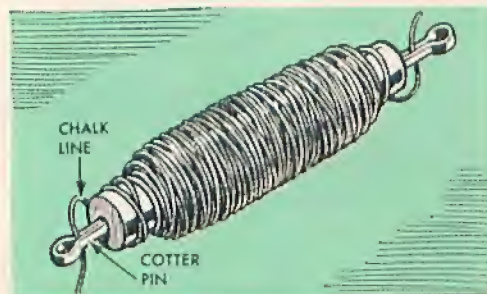
Friction Brake Stops Saw

Waiting for the blade to coast to a stop when making subsequent depth settings on a radial-arm saw is bothersome. However, with this hand-operated brake bearing against the side of the blade, you can stop the saw in seconds after it is shut off. It's merely a block of hardwood pivoted to the saw guard with a butt hinge. The action of the hinge is tightened by hammering the hinge barrel so it will stay retracted.



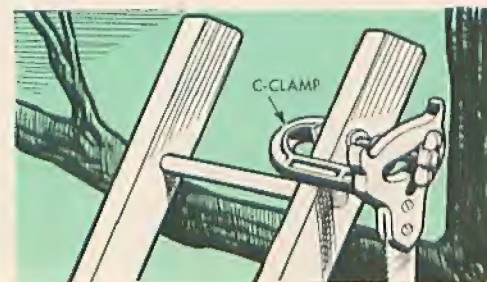
King-Size Compass

Need a compass for drawing large circles? You can improvise one from a rubber "washer" and twine. The disk, cut from an old inner tube, has five holes made with a leather punch at the points indicated. The twine is passed through the holes as shown and looped over a nail at the center point. After adjusting the twine for the desired radius, insert the pencil in the center hole and scribe the circle.



No More Tangles

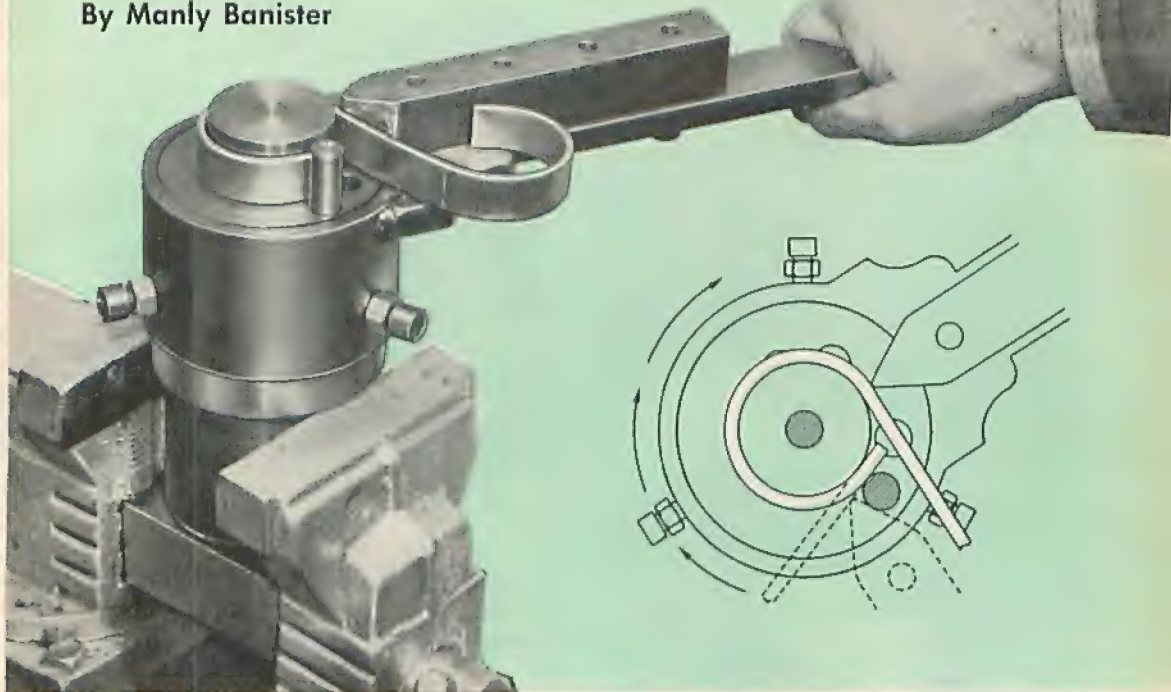
If you keep your chalk line or gardening line wrapped around a stick when it's not being used, the line is likely to unwind and become tangled and knotted. This can be easily prevented by drilling a hole in both ends of a dowel and force-fitting a large cotter pin into each hole. The line ends are then inserted through the eyes of the cotter pins and wedged into the pin to hold them securely in place.



Clamp Lends a Hand

Pruning a tree is the sort of job that makes you wish you had a third hand. Since few of us do, however, a C-clamp is the next best thing. Attached to the side rail of your ladder so that the thumb screw faces outward, the clamp provides a handy and safe place to hang your pruning saw when you're taking a breather or climbing to another rung to get in a more advantageous position.

By Manly Banister

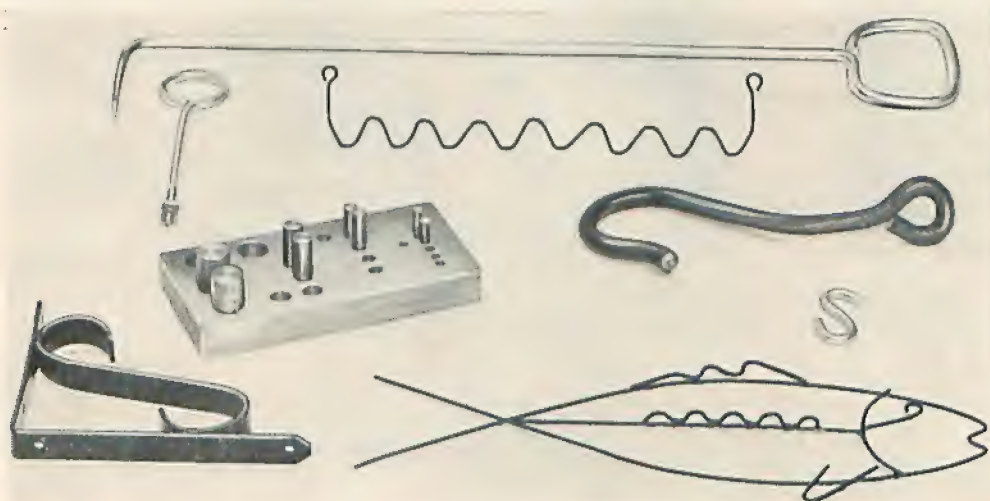


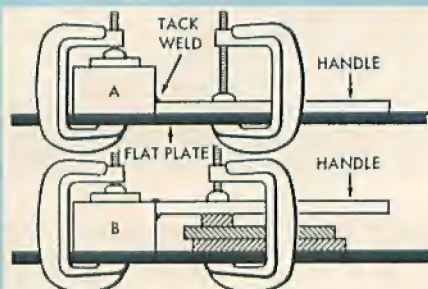
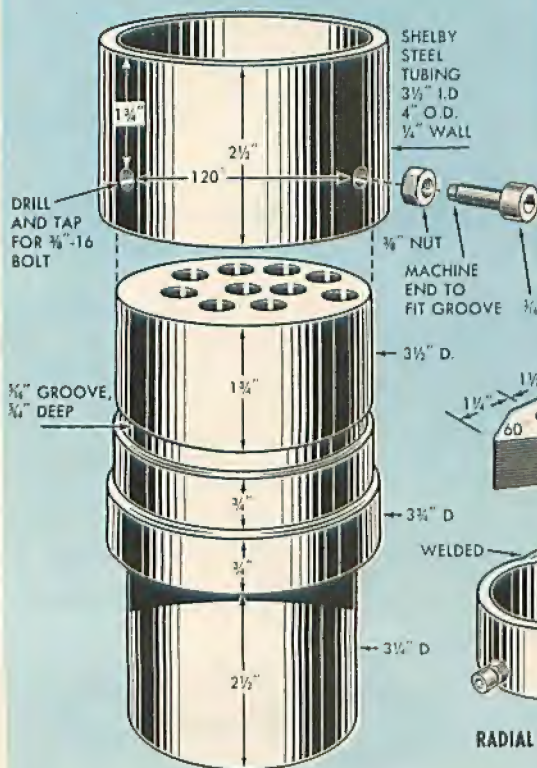
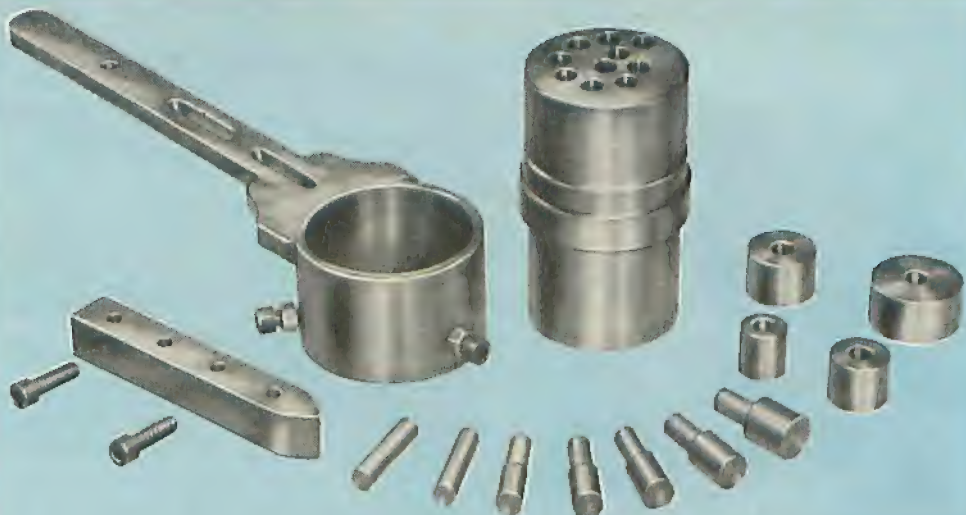
METAL BENDERS FOR THE SHOP

"GIVE ME A PLACE to stand and I will move the Earth," said Archimedes, to dramatize the potential of the lever. In the centuries since, the lever has indeed moved the world through a long history of technological development. There's never been a mechanical contrivance that didn't make use of the lever principle.

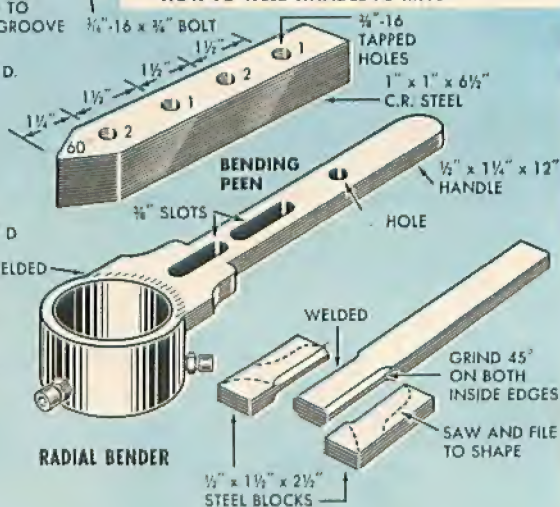
The bending jig shown above is no exception. By putting that principle to work around a circle, it lets you bend $\frac{1}{2}$ -in. steel rod (or $\frac{3}{16}$ -in. strap iron up to 1 in. wide) as easily as a circus strong man would—and a lot more accurately.

A second, simpler jig—and a sampling of the work it will do—is shown in the

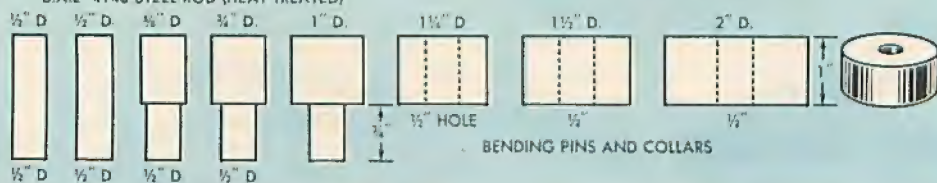




HOW TO WELD HANDLE TO RING



S.A.E. 4140 STEEL ROD (HEAT TREATED)



bottom photo. Its capacity is strip metal up to $\frac{1}{4}$ in. thick by $\frac{3}{4}$ in. wide, but using the smallest set of pins, it's ideal for bending wire. With this jig, the material to be bent becomes its own lever as you pull it against the pins.

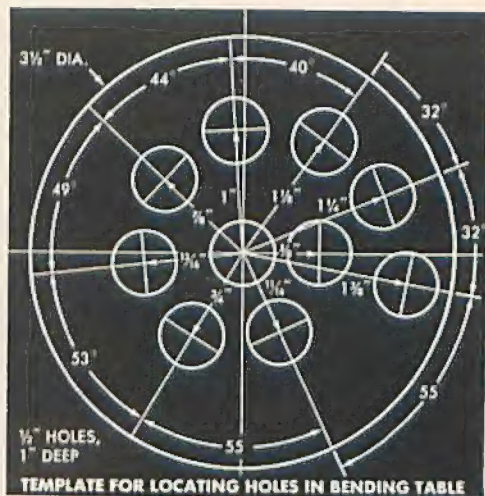
Work is shown in progress in the photo of the radial jig at the top of page 171. That's $\frac{1}{8} \times \frac{3}{4}$ in. annealed steel strap being bent around a pin collar to form a "wrought-iron" bracket.

To use this bender, you select pins (or collars) of suitable size, position them in holes just far enough apart to accept the material to be bent, then bring the point of the peen against the work and secure it by tightening the retaining bolts. That done, you swing the handle around—clockwise, as shown in the inset sketch, or counter-clockwise if the work is reversed, as for lefthanded use. A full turn produces an eye; a half-turn makes a U-bend; a quarter-turn forms a right-angle. Excess length is not needed, as it is when the work must supply its own leverage by extending well beyond the bend.

That's the case with the flat bender. It has no moving parts and is actually only a socket plate for clamping in a heavy-duty vise. Though simpler in construction, it is even more versatile, since it's four jigs in one, utilizing pins of $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$ and $\frac{3}{4}$ in. diameter, which handle a range of material from coat-hanger wire up through the heaviest material you can bend by hand—either cold or hot. If you want to make wire jewelry, add a series of $\frac{3}{16}$ and $\frac{1}{8}$ -in. holes, and cut matching pins. These will be just right for copper and silver wire.

Any bending jig must provide a variety of pin sockets since the best spacing between the anchor pin and the radius pin is just enough to pass the thickness or diameter of the work. In the radial jig, $\frac{1}{2}$ -in. sockets spiral outward at increasing distances from the center hole. A layout for drilling these holes is given at top right. Make a full-size pattern on tracing paper, tape this to the face of the bending table and transfer hole-centers to the steel with a prick punch. Retap these with a centerpunch before you go to the drill press. Then start with $\frac{1}{8}$ -in. pilot holes and work up to the final diameter through several drill sizes to keep drill-whip from enlarging or oblatting the holes.

The steel used for the body of the jig is a chrome-molybdenum alloy made for maximum resistance to abrasion, impact, and stress. Its industrial designation is A.I.S.I. A-4142 (SAE 4140) Moly-Krome. It's available both annealed and heat-treated. I used the latter for my jig as it requires no further treatment for home shop usage. If the annealed type is used

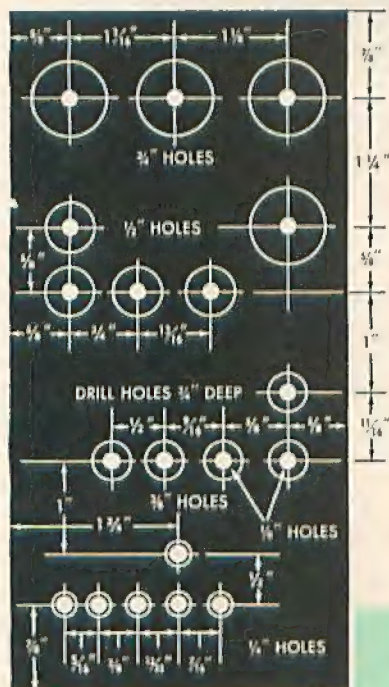
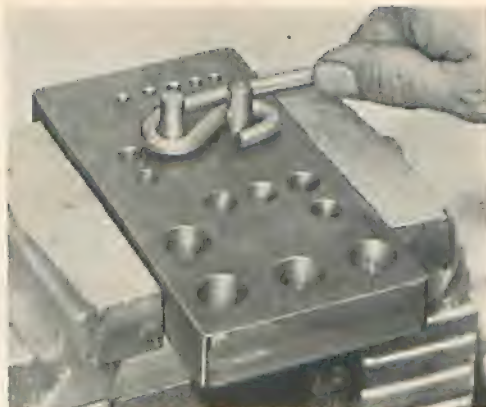


instead, you should have your local machine shop heat-treat it to prevent the pin sockets from "egging." I turned the body on a 6-in. lathe (with a milling attachment for cutting the slots and the peen point). But, be warned—heat-treated Moly-Krome is murder on cutting and drill bits. The groove around the body seats the three collar bolts that prevent the collar from working upward in use.

The photo at top left also shows a convenient spread of bending pins and collars. If you make pin sockets from drill rod, you can use them without hardening; but if you choose to harden them, be sure to temper them at not less than 800°. Otherwise the steel will be brittle and will snap off under pressure. Pins of low carbon steel can be case-hardened. The plans call for pins of different diameters for bending arcs of varying radii. For larger sizes, "doughnut" collars slipped over the center pin, are recommended, to save machining.

If you lack facilities to harden and temper the pins and other pieces, your local machine shop can do the job for two or three dollars. If you have a forge or blast furnace, bring the metal to a bright cherry red, then quench in clean, cold water, stirring vigorously with the tongs to cool as rapidly as possible. To draw some of the hardness and take away the brittleness, temper the metal in a 300° kitchen oven for an hour. Quench again in cold water and polish off the scale in the lathe with fine emery cloth. You'll know the pieces are properly hardened when they sound like those ball bearings Capt. Queeg always rattled in his hand.

The bending peen has four tapped holes to permit adjustment to various distances from the center pin. Turn retaining bolts into the No. 1 pair for light work. But



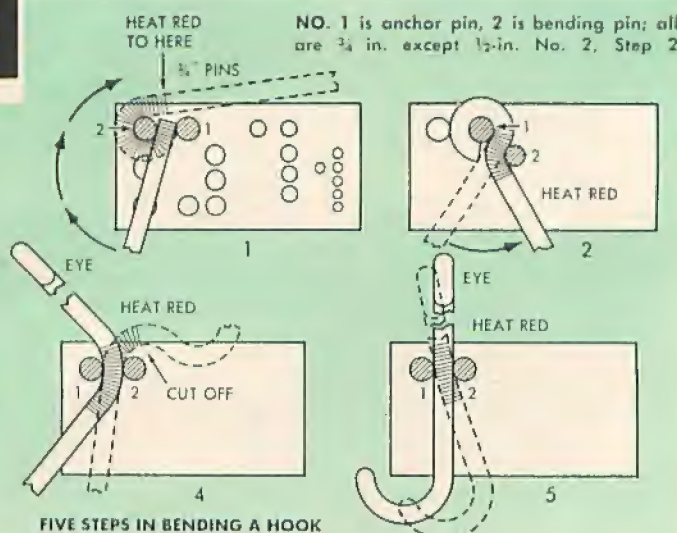
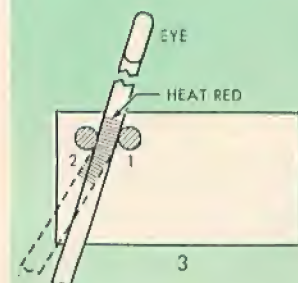
when you're bending heavy material, you can gain extra leverage by moving the peen back to engage the work an inch or so from the bending point. In such cases, use the No. 2 holes, passing the rear bolt through the handle hole located $8\frac{1}{4}$ in. from the ring. If you need more leverage than the handle can provide, slip a length of pipe over it.

The peen must be hardened, since the bending is all done with the anvil tip, and this would quickly score to the point of uselessness. This large piece of tool steel is rather expensive, but cold-rolled steel will serve as well if the point is case hardened. This can be done quite easily with a commercial product called Kasenit, from directions printed on the can. Or use a hard-surfacing electrode in an arc welder to lay a bead across the point and a couple on each side. Then grind the hard-surfacing deposit (stellite) to a rounded point.

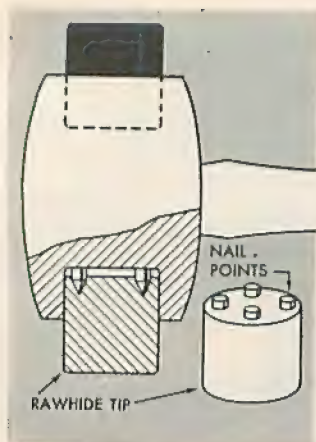
The handle can be cut from solid $\frac{1}{2}$ -in. sheet, or built up as sketched, page 172. After shaping, cut $2\frac{1}{4}$ -in. slots as shown. The $\frac{3}{8}$ -in. bridge between the slots is merely to avoid weakening the handle. A detail on page 172 shows how to join handle and

(Please turn to page 198)

$\frac{1}{2}$ " x $3\frac{1}{2}$ " x 7" STEEL PLATE
UNIVERSAL BENDING JIG

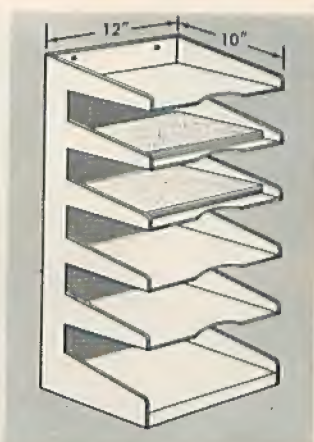


FIVE STEPS IN BENDING A HOOK



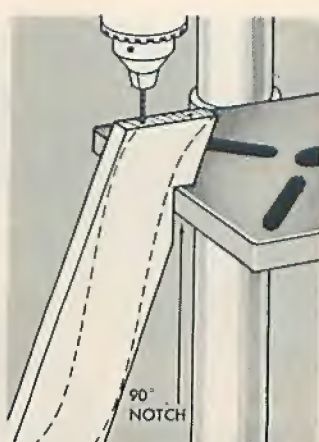
Mallet Tip

To tighten loose rawhide inserts in a mallet, drill four $\frac{1}{8}$ -in.-deep holes in the inner face and insert the cut-off tips of four large nails, points down. Nails should project about $\frac{3}{16}$ in. and be filed flat. When squeezed in a vise, nails will expand insert.



Sandpaper Rack

A steel letter tray designed for office use makes an ideal rack for storing sandpaper. If you don't have such a rack, you can make one out of plywood scraps. Use $\frac{3}{8}$ -in. or $\frac{1}{2}$ -in. for the back and $\frac{1}{4}$ -in. for the sides and shelves. Assemble with brads and glue.



Notch Holds Work

When drilling dowel holes in splayed furniture legs cut from flat stock, you'll find it easier to support the pieces if you drill the holes before bandsawing the legs. Simply cut a right-angle notch in the waste portion to hook over edge of drill-press table.

Tubing Takes Pinch out of Mower Starter Cord

Does your power mower pinch your fingers when you yank on the starter cord? You can prevent this by pressing a short length of metal tubing through the

hole in the starter-cord handle. This insures a safe clearance between the handle and the cord, preventing injury to your hand.—Henry Hanscom

NEXT MONTH IN SHOP AND CRAFTS

- ★ **HOME FIRE ALARM.** It's an old saying among firemen that "the first five minutes at any fire are worth the next five hours." In the June issue, *PM* shows you how to install low-cost alarm system operating off the transformer which powers your electric doorbell. For all the details on this home-safety special, pick up a copy of next month's issue of *PM*.
- ★ **ATTENTION R/C FANS.** In the June issue you'll find complete plans and building instructions for a hot little three-point hydroplane with a big design advantage—it's air-driven and the gear is directly interchangeable with a regular R/C airplane. Sleek and streamlined, this 40-in. speed-demon is extremely stable and a thrill to run. Watch for it in the June issue.
- ★ **ROLLAWAY PICNIC TABLE.** Two unobtrusive wheels make this smart circular picnic table completely portable—wheel it out into the middle of the patio or lawn when you want to use it, then roll it back out of the way after the meal. Its lazy Susan provides a handy carousel for condiments, and best of all, it's a breeze to build. Don't miss this one.
- ★ **GOT A BOAT?** If so, you want to keep up to date on all the new synthetic lines—which one is best for mooring, which for anchoring and what type for towing skiers. In the June issue of *PM* you'll find a detailed discussion of modern line lore pointing out the strengths and weaknesses that determine the proper use for each of new synthetics. Be sure to get it.

WAVING HANDS generate unearthly music as they near sensing plates



Theremin Electronic Music Maker

Achieve fascinating musical effects by just waving your hands

By John Potter Shields

HERE'S A PROJECT that's real fun. Patterned after the "musical" instrument that makes all those eerie shrills and squeals in horror movies, this theremin will end up as a source of both amazement and amusement for the entire family.

The theremin produces musical tones when the performer's hand is brought within an inch or so of a metal sensing plate—the pitch of the sound changing as the distance between the hand and plate is varied. At no time should the hand actually touch the plate. While many circuits for theremins have appeared through the years, they have generally used vacuum tubes, with their associated heat and bulkiness, and have been either overly complex or so simple that their operation left much to be desired.

How It Works

The transistor theremin described here uses no tubes, and while its circuit is relatively simple, it produces excellent results. The circuit uses only standard, easily obtained components—no special coils or transformers are required for its assembly

and the total cost of parts is well within reason for an electronic musical instrument of this type.

The theremin actually consists of two basic sections—a pitch generator and a volume control. The pitch generator (left hand side of the schematic on pages 178 and 179) consists of two variable frequency oscillators (transistors Q1 and Q2). In operation these oscillators are adjusted to produce two frequencies with a difference of approximately 1000 cycles between them. Now, when the theremin player's hand approaches the "pitch-sensing" plate, the frequency of one of the oscillators changes because of the additional external capacitance the hand adds to the circuit.

This capacitance, in turn, changes the difference frequency of the two oscillators. This difference frequency is turned into a usable beat frequency by feeding the outputs of the two oscillators to a diode mixer (D3). Since the frequency difference of these oscillators may vary anywhere from a few cycles to 5000 cycles or more, depending on the amount of hand capacitance added to the circuit, the re-

sulting beat frequency will also lie in this range.

The beat frequency signal is amplified by transistor Q3 and passed on to transistor Q4. But Q4 will amplify the beat signal only when it receives no signal from the volume-control circuit. (This is when the theremin player's hand is close to the volume-sensing plate. When the player's hand is drawn away from the volume-sensing plate, the volume circuit feeds a signal to transistor Q4 that reduces its amplification, thus lowering the level of the output signal.)

To simplify, the volume of the signal is controlled by the volume circuit (right side of the schematic diagram). When the player's hand is brought near the volume-sensing plate, the added capacitance effect of the hand turns off a volume-limiting circuit and permits maximum amplification of the tone generated in the pitch section of the theremin.

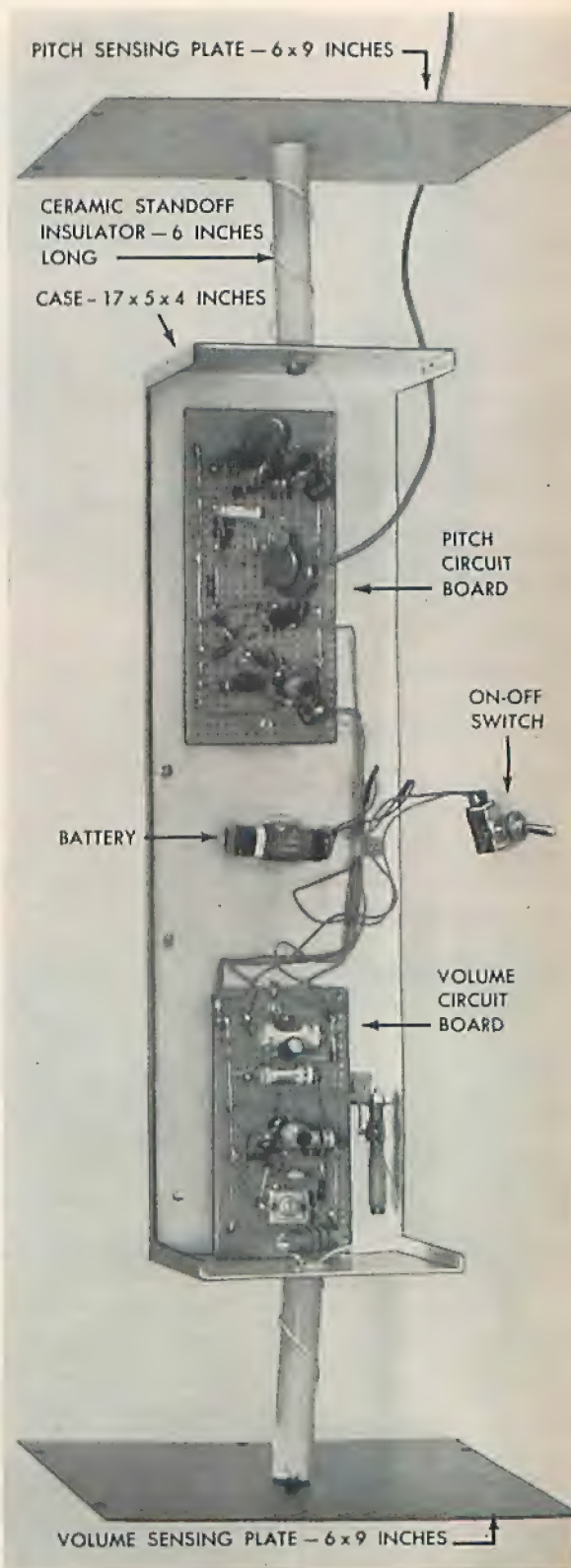
Let's Build One

As shown in the photos, the working electronics of the theremin are built onto two separate circuit boards. This is done to prevent any interaction between the separate pitch and volume sections. Although perforated phenolic boards were used in the original model, arrangements have been made with Specialized Electronics Inc., 850 Euclid Ave., Cleveland 14, Ohio to supply two etched circuit boards at \$4.65 per board postpaid. The same boards with all components mounted and the circuits aligned may be obtained for \$28.35 each, postpaid.

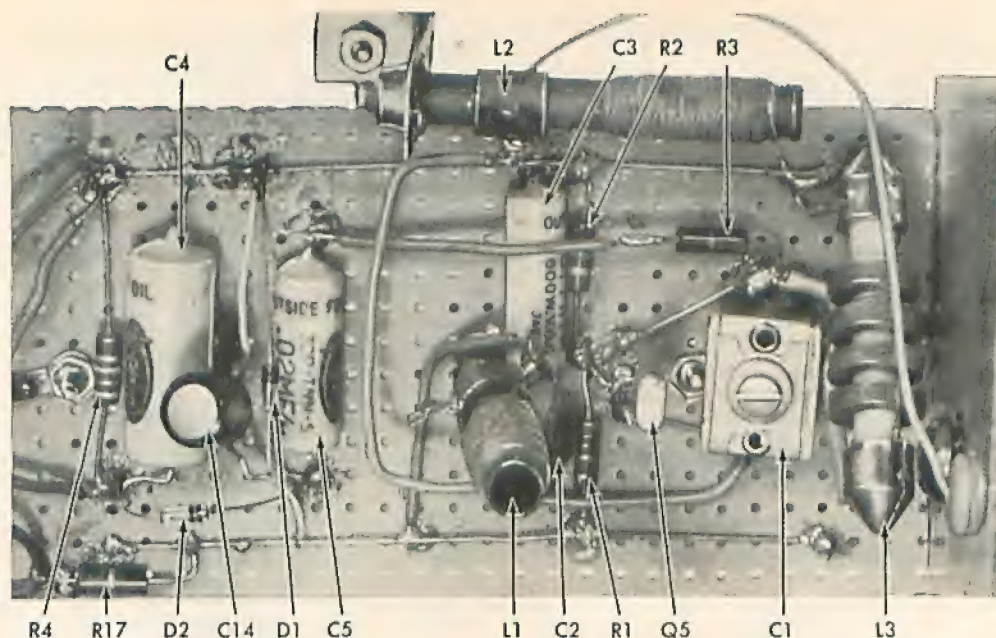
The circuit boards are mounted on opposite ends of a 17 x 5 x 4-inch case. Insulating standoffs keep the wiring on the bottom of the boards from shorting to the metal case. A standard make microphone stand fixture is attached to the bottom of the case for mounting the theremin to a microphone stand. This keeps the pitch and volume-sensing plates clear of surrounding objects. It also places the theremin at a convenient playing height.

The sensing plates are simply two 6 x 9-inch aluminum sheets mounted about 6 inches from the main theremin case at the ends of two 6-inch long ceramic standoff insulators. The 9-volt battery is held in place by a simple spring battery holder clip. Power used is slight, insuring long battery life. The theremin output can be fed to almost any audio amplifier and speaker.

Check both boards carefully before



HERE'S HOW the major components are arranged inside the metal case. On-off switch mounts on the back

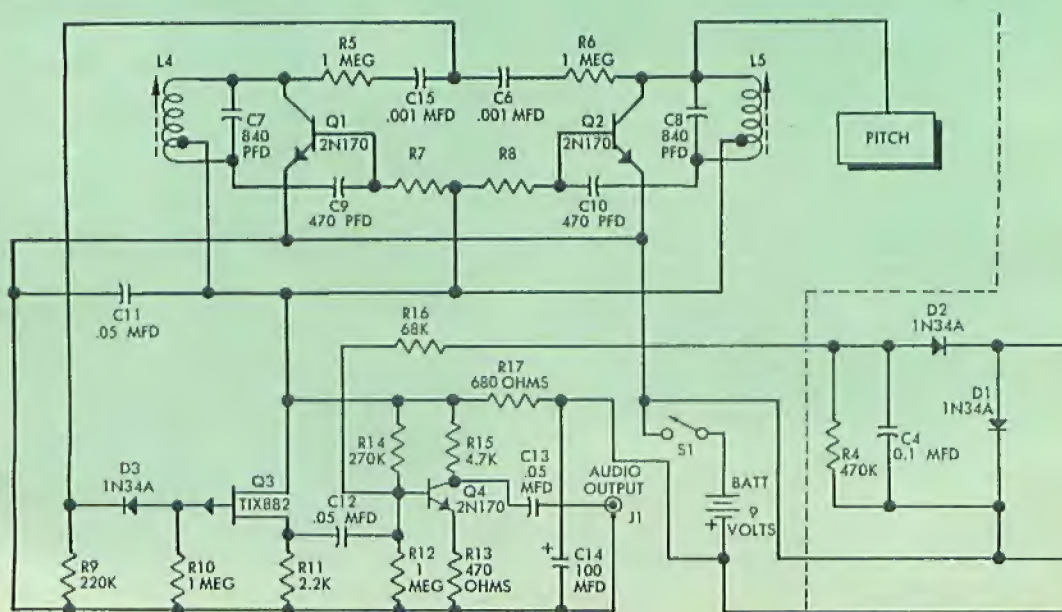


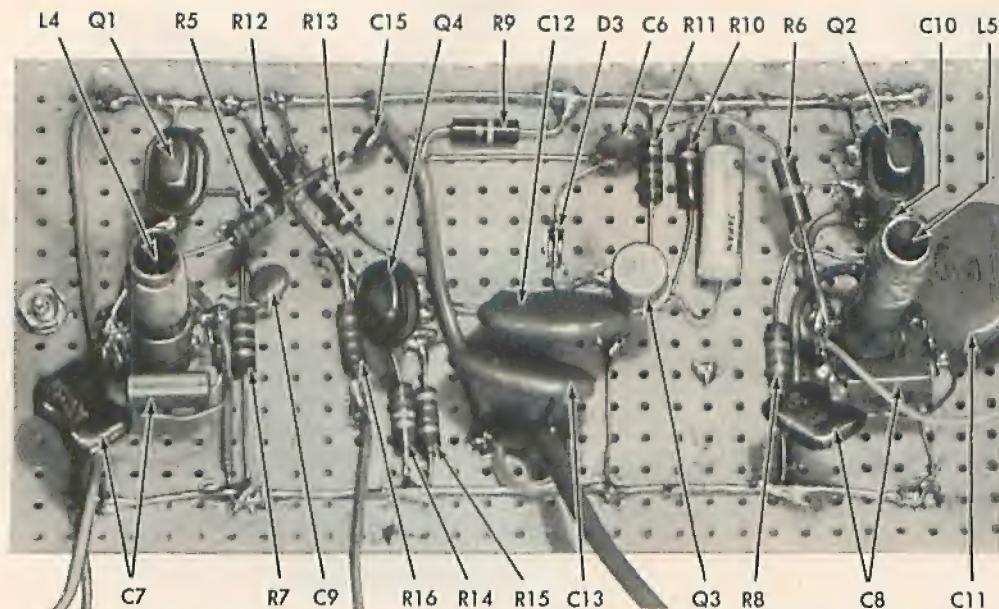
CLOSE-UP view of the volume circuit shows exactly where each individual component is mounted on the board

mounting them in place. When mounted they should be at least 6 inches apart. Then make all the interconnections between the boards, except for the lead from resistor R16 in the pitch circuit to the junction of R4, C4, D2 in the volume circuit. Now connect a length of shielded cable between jack J1 and the input of an audio amplifier, connect the 9-volt bat-

tery and turn switch S1 to ON. Turn the slugs in coils L4 and L5 until they are approximately halfway out. Now adjust L5's slug (either in or out) until you hear a tone. Do not touch L4 at this time. Once you get a tone you should be able to vary it by moving your hand nearer to or further away from the pitch sensing plate. If all is in order, L5 can now be

SCHEMATIC DIAGRAM of the theremin. Pitch circuit is below, volume circuit to right of the dashed line





THE PITCH CIRCUIT BOARD is rather crowded, but follow this parts layout and you'll have little trouble

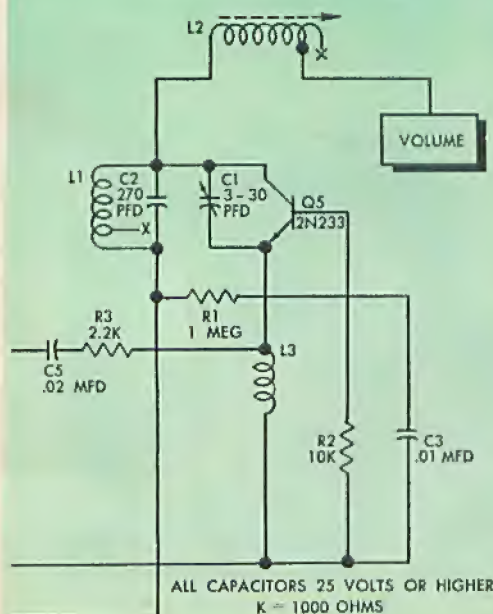
adjusted for the most pleasing tone range.

Adjusting the volume-control board comes next. First make the final connection (R16 to D2, C4, R4). Now with power on, place a hand on the volume sensing plate and adjust trimmer capacitor C1, turning counter-clockwise about three full turns. Now remove your hand from the volume-sensing plate. Volume should drop

appreciably as you move your hand. If not, turn C1 clockwise until the volume does drop (do not touch the volume sensing plate during this adjustment). Now when you bring your hand near the plate the volume will increase. A little experimenting here will result in smooth volume-control action. Adjust L2's slug for maximum volume. ★ ★ ★

PARTS LIST

- R1, R5, R6, R10, R12—1 megohm, 1/2 watt carbon
- R2—10,000 ohms, 1/2 watt carbon resistor
- R3, R11—2200 ohms, 1/2 watt carbon resistors
- R4—470,000 ohms, 1/2 watt carbon resistor
- R7, R8, R16—68,000 ohms, 1/2 watt carbon resistors
- R9—220,000 ohms, 1/2 watt carbon resistor
- R13—470 ohms, 1/2 watt carbon resistor
- R14—270,000 ohms, 1/2 watt carbon resistor
- R15—4,700 ohms, 1/2 watt carbon resistor
- R17—680 ohms, 1/2 watt carbon resistor
- C1—3-30 PFD, mica padder capacitor
- C2—270 PFD, mica capacitor
- C3—.01 MFD, disk ceramic capacitor
- C4—.01 MFD, paper tubular capacitor
- C5—.02 MFD, disk ceramic capacitor
- C6—.001 MFD, disk ceramic capacitor
- C7, C8—840, PFD, mica capacitor
- C9, C10—470 PFD, mica capacitor
- C11, C12, C13—.05 MFD, disk ceramic capacitor
- C14—100 MFD, tubular electrolytic capacitor
- L1, L2, L4, L5—antenna coil (Miller 2002)
- L3—2.5 MH, rf choke (Miller 6302)
- Q1, Q2, Q4—2N170 transistors
- Q3—TIX-B82 transistor (Texas Instruments)
- Q5—2N223 transistor
- D1, D2, D3—1N34-A diodes
- BATT—9 volts (Burgess 2U6 or equivalent)
- S1—spst toggle switch
- J1—phono jack (RCA type)
- Case—17 x 5 x 4 inches
- Sensing plates—6 x 9 inches
- Battery clip
- Male microphone mount
- Miscellaneous hardware



New in Electronics

PILLOW TALK PHONOGRAPH lets you lie back and relax while listening to the latest stereo records. Two 4-inch permanent-magnet speakers are buried in the polyurethane pillow (see inset). They are positioned for perfect stereo listening. Made by General Electric, the pillow speaker can also be used as a conventional speaker system, either stored in the lid of the phonograph or as a self-standing remote unit. Price is \$79.95 for both the automatic stereo phono and the speaker system



DESOLDERING IRON makes for rapid electronic circuit repairs. It melts and vacuums away the liquid solder leaving terminals and mounting holes clean. Once solder is out of the way, defective parts can be removed easily. Then replacements can be soldered into place with the same iron. One-hand operation makes its use no more complex than standard irons. Right-angle, fine-tip design reaches into corners that are normally inaccessible. Operating temperature is reached in two minutes and is thermostatically controlled. The Endeco desoldering iron is made by Enterprise Development Corp., 1102 E. 52 St., Indianapolis 5, Indiana. It sells for \$24.95

QUICK CB EQUIPMENT TUNEUP is no trouble at all with this portable transistorized 10-function CB checker. Measures relative SWR, output power, percent of modulation, field strength and crystal activity. Can also be used as signal monitor, crystal controlled rf generator or a code-practice oscillator. A 40-inch antenna, large meter, and built-in dummy load make it an all-purpose CB tester. Model Ten-2 is \$25.95 (kit), \$39.95 (wired) from Allied Radio, 100 N. Western Ave., Chicago, Ill.





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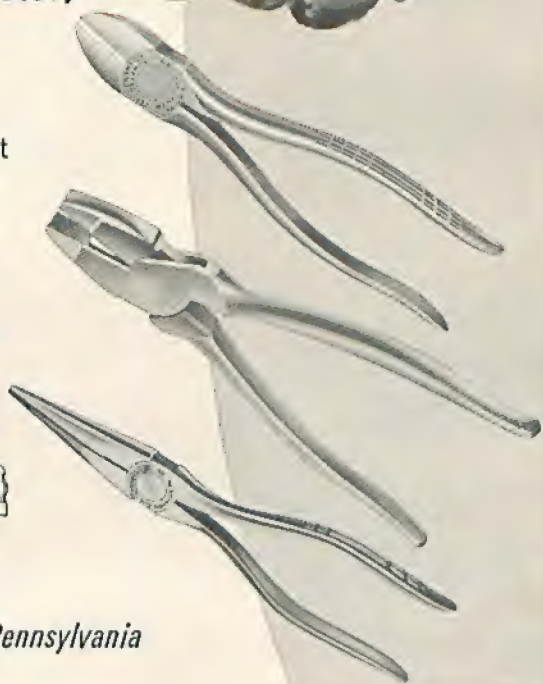
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CLINIC FOR HOMEOWNERS

Q I'm planning a home with a crawl space. Drainage about the structure is reasonably good. I want to insulate the floor but the question of where to locate the vapor barrier has arisen. Should the barrier be above or below the insulation?—F.R., Wis.

A When building a structure—you did not say but we are assuming the home to be of conventional frame construction—there are precautions to be taken other than insulating the floors. If you can be sure of adequate ground drainage, then, in addition to insulating the floors, there should be screened vents in the foundation walls well above grade level to permit air circulation the year around, pressure-treated joists and sub-floor boards should be used and there should be a gravel or crushed-rock fill at least 5 in. deep covering the area enclosed by the foundation walls. As added precaution some builders lay a plastic membrane over the fill, cement the joints or laps, and extend the edges up the foundation walls a foot or more and cement these edges to the walls. This helps to prevent ground moisture from rising into the crawl space. The vapor barrier then should be placed above the insulation and just under the subfloor. There is little chance of condensate forming during the warmer months as the ground temperature is usually less than the floor temperature. Incidentally, in connection with placement of vapor barriers it should be noted that in second homes or vacation homes left unheated during the winter months the vapor barrier should be placed under the insulation as the floor temperature during the unheated period is usually lower than the ground temperature.

Q What's the best method of staking tomatoes in a small home garden? Some tell me that the plants should be supported on square frames at a height of about a foot or so above ground. Others say that the vines should be tied progressively as growth occurs to tall stakes, one plant to each stake. Which is best?—A.L., Ind.

A Both methods are good and are rather widely used by gardeners. Which method to use depends to some extent on the area available, the proximity of shrubbery, small trees and structures that may retard air circulation, the type of soil and the natural drainage. Where one must of

necessity plant tomatoes in a rather heavy soil under relatively poor drainage conditions it usually is best to train the plants to single stakes 4 to 6 ft. tall. Another obvious advantage of the single stake is the economy of space in a small garden plot. On the other hand, in an open, airy garden plot where space is not a major problem it generally is advantageous to support the plants on frames 20 to 24 in. square, the frames being supported on stakes at a height of about 16 to 18 in. above ground level. Of course, the main reason for staking or otherwise supporting tomato plants is to prevent the fruit from contacting the damp ground which can cause spotty ripening and faulty coloring due mainly to a lack of adequate sunlight.

Q What causes checking and wrinkling of paint on wood siding? In this I'm not thinking of blisters, but checks and the fine wrinkles that develop.—O.D., Ga.

A Checking and wrinkling, also curling of the paint film at the breaks, are often various stages of the same thing. Usually the initial cause is moisture penetrating the walls from the room side, but later, after the breaks have opened, moisture from the outside collects under the film and causes the curled edges you see at this stage. On the other hand the wrinkling you mention often is the result of a too heavy application of paint, application of paint not properly reduced to brushing consistency, or application of a top coat over a first coat not completely dry. In individual cases there can, of course, be other causes but these are less common. Unfortunately, the remedy or correction of such conditions is not simple or easy. Usually it is necessary to scrape off the loose paint, apply a prepared undercoater and a top coat properly thinned to brushing consistency.

Q How does one clean white ceramic tile? It's old and the joints have become discolored with grime.—M.K., Ia.

A After going over the floor with a cleaning solution apply a thin paste of white portland cement to the dampened surface and then wipe off with a coarse cloth or burlap. Wipe off in all directions to work the white paste into the joints. The procedure usually produces fairly satisfactory results on older ceramic floors still in good condition.

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will slice through them with ease.

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The Motor

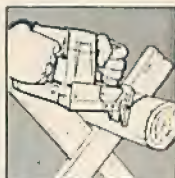
The Skil Model 577 is equipped with what is termed a "Super Burnout Protected Motor." That means its windings are coated with a special polyester resin insulation that resists overheating. It will withstand frequent high temperature overloads with no danger of damage to the motor.

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There's something new for everyone. More models, more features, more quality. More deep-down, through-and-through, top-to-prop Johnson dependability than ever before.

Is a Johnson built that much better? Yes—and better! Two facts help prove it. 1. More Johnsons have been sold than any other brand. 2. Johnson's special

two-year warranty* is unexceeded in the industry.

Your Johnson dealer's (he's in the Yellow Pages) '64 line-up includes 13 models in 9 power classes: 90, 75, 60, 40, 28, 18, 9½, 5½, and 3 hp. And all of them cut oil costs in half with a new 50 to 1 gas-oil mix.

Johnson Motors, 1691 Pershing Rd., Waukegan, Ill. Division Outboard Marine Corp.

*For 24 months after purchase, Johnson Motors will replace, without cost to the original purchaser, any part of its manufacture which upon inspection proves to have failed in normal use due to faulty material or workmanship.

See your Johnson dealer for the fabulous new LP jazz album "The Hot Ones." Only \$1.00

Johnson . . . first in dependability ➡

Fold-Up Scooter

(Continued from page 169)

with the required amount of color, add catalyst and stir thoroughly. Brush a coat of this colored resin over the outer surface and edges of both fenders, then let it cure while you wash brushes and containers in acetone. When hard, sand smooth with medium-grade paper.

Mix and apply another coat. Apply as many coats as you feel are necessary, sanding each smooth when dry. If you used white paste, as we suggested, you'll find the coatings come out with a semi-gloss, off-white finish. Upon this ground, a single coat of epoxy paint—the same paint you'll use on the frame—will produce a rich, glowing luster that can't be equalled by fiberglass colors.

If you've got fiberglass materials left over, you might want to mold the chain guard and the brake drum cover of fiberglass, instead of metal. The technique is the same, except you can skip the pigment in the gel-coat since the inside won't show.

Photo and sketch on page 168 show the twist throttle control mounted just inboard of the left handlebar, but it can be located on the right just as well. Some kind of stop arrangement must be provided so the throttle-control wire won't be damaged by over-twisting. The free end of this wire is hooked around the bolt that passes through the two pieces of aluminum forming the stop tongue (the second, shorter piece is merely to build up a thickness that's easier to manipulate with the fingers). When you twist this tongue downwards, the control wire tugs the engine's throttle open. Moved in the opposite direction, the control shuts down the fuel feed, for idling. The two stop screws are tapped through both the retaining ring and the handlebar. The inner stationary ring is secured with a single setscrew.

The brake drum is a purchased unit, bought with the wheels. But you'll have to make the pedal linkage, as shown on page 166. The pedal itself is bent from $\frac{3}{8}$ -in. mild steel rod. It pivots on a pin machined from $\frac{1}{2}$ -in. rod, then heated cherry red, quenched in cold water and baked in a 300 degrees oven for an hour to draw the temper and remove brittleness. As shown in the photo at the top of page 169, a small spring is mounted at the tip of the stop-light switch's lever. This proved necessary since the switch itself has a spring that tugs the lever forward. Slack in the brake mechanism prevented pulling the lever far enough back to switch off the stoplight—until the counter-spring was added. The photo also shows a double wire-connector

(Please turn to page 186)

ONLY THING BETTER THAN ONE 40^H_P JOHNSON



THREE 40^H_P JOHNSONS

Pick your pleasure, pick your price!

1. Electramatic Drive . . . outboarding's first truly automatic transmission.
2. Electric Starting . . . just turn the key and your boating fun begins.
3. Manual Starting . . . economy model for bargain-minded boaters.

The Super Sea-Horse 40 is a powerful match for most any boat. And all three models have all these features. Full silencing system. Fixed high-speed carburetor jets. Thermostatically-controlled cooling system. Plus choice of propellers. Also, like all '64 Sea-Horse motors (13 new models in 9 power classes: 90, 75, 60, 40, 28, 18, 9½, 5½, and 3 hp), they cut oil costs in half with a 50 to 1 gas-oil mix and carry a 2-year warranty.* See your Johnson dealer for complete details. He's listed in the Yellow Pages.

*For twenty-four months after purchase, Johnson Motors will replace, without cost to the original purchaser, any part of its manufacture which upon inspection proves to have failed in normal use due to faulty material or workmanship.

Johnson

Johnson Motors, 1693 Pershing Road, Waukegan, Illinois. Division Outboard Marine Corporation



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is too
small to show you
all the things
you can fix with
Elmer's
Epoxy glue...**



**so we put it
all in a
free book.**

Mail this coupon today, along with a stamped, self-addressed envelope to: Elmer, The Borden Chemical Company, Dept. PM-54, 350 Madison Ave., New York, N. Y. 10017. (Available in Canada.)

Yes! Send me a free copy of your booklet, "Working with Elmer's Epoxy," showing me how I can easily repair metals, glass, china, marble, brick, and most plastics stronger than new with Elmer's Epoxy Glue and Elmer's all-purpose Epoxy-Metal compound.

NAME _____

ADDRESS _____

CITY _____

ZONE _____ STATE _____

Fold-Up Scooter

(Continued from page 184)

above the switch. This option permits "breaking" the wire at this point if you ever have to remove the front fork.

The battery hanger is made of Do-It-Yourself aluminum. No dimensions are given, since it must be tailored to the battery you choose. A wet battery is best, since it's easiest to keep charged. (You need it only for the light system.) Small motor-cycle batteries, like the one shown, have non-spill tops that won't leak electrolyte when the scooter is folded for transport.

The gas tank won't leak, either, in the folded position, but the movement of travel may slosh gas out the perforated gas cap. You should either travel with an empty tank, or replace the cap with a solid one until you reach your destination.

Ready for the road? Mix a pint of regular gas with 1½ oz. outboard motor oil for two-cycle engines, and fill the tank. Close the choke, open the throttle and pull gently on the starter cord a few times. If it doesn't start at once—or if the engine has stood unused for awhile—remove the air cleaner and squirt a few drops of the gas-oil mixture into the carburetor orifice.

As soon as the engine starts, open the choke and ease off on the gas. You can warm the engine at full throttle by lifting the front wheel, as shown on page 165.

Before you take off, though, remember that the scooter is a motor vehicle, and as such is subject to local laws and regulations. To ride it on public streets, highways and beaches, you'll probably need a driver's license (some states require a special scooter license). Usually, the vehicle itself must be licensed. As shown on page 169, the bike's equipped for licensing in the author's own state of Oregon, but contact your motor vehicle department to check on local requirements and equip your scooter accordingly.

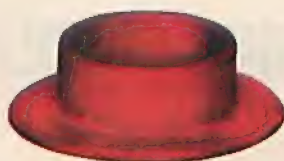
Now: what has the project cost you? Well, if you bought all materials and accessories new, at list prices, you probably ran just over \$200. But special deals on the wheels, hubs, brake unit, sprockets and engine can pare this down considerably. And you can omit those classy fenders.

Riding this midget is a sensation unlike anything else on wheels. Since it's virtually out-of-sight, under you, you get the uncanny sense of being lifted and swept along by the wind. The scooter performs well on any hard-surface road—paved or not, rough or smooth—but not in unmown grass a few inches long. There's a limit, after all, to what ¾ horse will pull. But who wants to chase cows around a pasture anyway? ★★

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TORCH OWNERS**



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It's BernzOmatic's Twin-Pack Special . . . two easy-to-work-with aluminum fuel tanks plus a free 79¢ torch stand for added workshop convenience. Get the working heat you need to fix up your home or boat or cabin. Get up to 30 hours of working time with the lightweight new seamless aluminum cylinders to install and sweat copper tubing, peel paint and putty, repair gutters, add an outdoor faucet, fire up the charcoal grille, loosen rusty nuts and bolts. Get this money-saving special offer from BernzOmatic in hardware stores and departments everywhere.

BernzOmatic Corporation, Rochester, N. Y.



Obtain Your Own Patent

(Continued from page 105)

my invention (classification 15) and checked the descriptions of all patents that seemed remotely similar to my car washer. In all, I looked up hundreds of micro-filmed patents. One result of this research was the rather disturbing discovery that only one of these patents had been prosecuted by the inventor without legal counsel. But, it was encouraging, too; if he could do it, I could do it too.

I read or scanned every book in the Chicago Public Library on patents and patent law (classification 608.0). Two 15-cent pamphlets from the Patent Office—*Patents and Inventions* and *General Information Concerning Patents*—also were of help.

When I felt I was ready I bought a sheet of Bristol board, and on my dining room table I made what I thought was a typical Patent Office drawing of my perfected car washer. Although I'm not a draftsman, I fortunately had taken drafting in school.

I wrote my application, using the proper terminology as far as I could determine it from all of my research. An application consists of four parts: a petition, a specification, the claims, and the oath. My wife typed the result, and I mailed the application and the drawing, together with the

\$30 filing fee, to the Patent Office.

Two months later my wife called me at my office. She was in tears. A letter from the Patent Examiner to whom my application had been assigned said that my drawing was incorrect in several details, and that *all my claims had been rejected*.

Because I knew from my research that this is what usually happens to an application, I was not discouraged. The letter referred to certain other patents which supposedly covered my claims. I immediately ordered copies of these patents. In a burst of optimism, I also wrote the Patent Office, requesting that the official draftsman make corrections to my drawing at my expense. This cost six dollars.

Then began a 12-month period of correspondence with the Examiner. I answered his objections, pointing out why my invention was *not* covered by the previous patents, and why it was a genuine "advance in the art." He made further objections, often citing other patents.

As the correspondence with the Examiner progressed, he began to grant a point here, a point there.

My first hint of success came on December 6, 1962, when the Examiner indicated that of the nine claims I was making, one appeared allowable. This claim cov-

(Please turn to page 190)

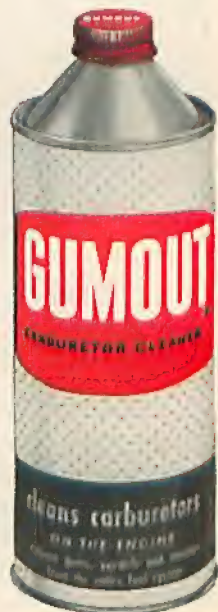
these small specks

CAN RAISE YOUR GASOLINE BILLS

25%

It takes only a *tiny* speck of dirt or gum at a vital spot to foul up your car's carburetor...resulting in hard starting, loss of power, stalling, wasted gasoline. That's why it pays to clean your carburetor with GUMOUT. Just add GUMOUT to your gas tank. It cleans your carburetor quickly and effectively as you drive. Available from your service station or auto supply store.

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If we told you that you could assemble and put up your own custom aluminum awnings in less time than it takes to mow your lawn (and save a bundle doing it), would you be interested?



You would? Good. We've got just the thing: Kirsch Sunaire aluminum awnings. They give you the beauty and comfort of custom awnings. Inexpensively. Because there are no assembly or installation costs. And they cost less than comparable awnings to begin with.

Easy to assemble? Sure. Simply put the prefitted 4" x 36" aluminum panels and other parts together. (See assembly steps.)

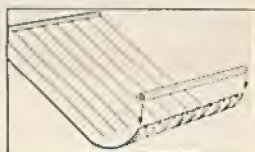
Maintenance-free Sunaire awnings are strong enough to meet the toughest rigidity tests, yet light enough to be handled by anyone. They come in a variety of colors. Mix or match panels to suit your taste and home.

Sunaire awnings are made by Kirsch, the

nation's leading drapery hardware maker. So you can feel very sure of quality. For the full story and the name of your nearest dealer, drop us a line at 501 Prospect, Sturgis, Michigan.



The panels snap securely together to fit windows of any width. (No bolts or screws are needed.) If desired, the assembled awnings may be taken down and stored.



Self-locking channels slide on top and bottom of awnings. Mount the brackets and projection arms on your home. (Takes just minutes with a screwdriver.) Hang the awnings and your job is done.

Kirsch
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Put some **FUN** into your
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WITH A

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Shown
with rotary mower

Mowing, cultivating, snow removal, all the hard jobs become a lark with this rugged, nimble tractor. Sturdy and powerful—but safe and simple for the whole family. No-Shift Glide-matic Drive—no gears to strip. Hugs ground—weighs over 500 lbs., far more than most other garden tractors. Famous Pennsylvania quality construction means long, hard use without repairs. Easy-to-start 6 H.P. or electric-starter 8 H.P. engine—plenty of power for every job.

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Dept. 145, Waynesboro, Virginia 22980

Obtain Your Own Patent

(Continued from page 188)

ered only the spray shield for the washer.

Again I fought for my other claims. As a result, the Examiner wrote that my claims cut across two different subcombinations of patents, and that I would have to elect one subcombination or the other, which would eliminate some of my claims. To this I agreed, reserving the right to apply for another patent later (which would cover the attachments).

Three Claims Allowed

On July 10, 1963, the Examiner informed me that three of my claims appeared allowable, but that the others were rejected. Again I answered with my own arguments.

My determination finally bore fruit. On October 17, 1963, I received a final paper, a "Notice of Allowance," granting six of my claims. I promptly sent off the \$30 required for the patent.

On December 24, 1963, my patent was finally issued. Quite a Christmas present.

In all, the patent cost me \$66, a figure that does not include the materials for the invention, nor the rather large postage bill for correspondence.

Now that I have my patent, I am just as determined to see my invention marketed, and just as optimistic. I've already contacted several manufacturers. I also made up my stubborn mind to interest a magazine in an article on my somewhat unique experiences (in order to call my invention to the attention of interested manufacturers) and what better magazine than *Popular Mechanics*?

A spokesman for one large manufacturer told me that immediately after World War II his firm had set up a research division for the express purpose of coming up with a new car-washing gadget. After an investment of two years' time and more than \$100,000, nothing had been accomplished. It makes my basement efforts seem puny—but even more satisfying.

I have only one regret. All of my correspondence with the Patent Office was signed by "L. Machlin," the Examiner assigned to my case. I've never met the man, nor do I have any mental image of him. All of our correspondence was couched in Patent Office terminology. Despite the cold, businesslike words, I'm sure that the vehemence of my feelings frequently showed through in my letters. And from his letters I somehow got the feeling that he understood my problems.

Some day I'd like to meet "L. Machlin" to thank him for his help. Although I may be a determined man, he's a patient one.

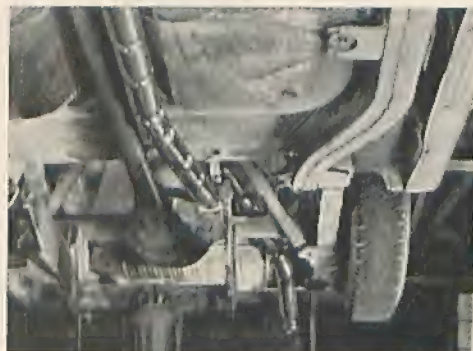
★★★

Walker Chambered Pipe is here!

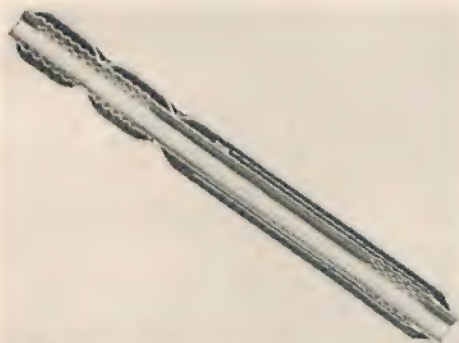
*THE REVOLUTIONARY NEW STREAMLINED EXHAUST SYSTEM
THAT GIVES YOU MORE POWER AND BETTER GAS MILEAGE.*



NOW YOU CAN PUT IT ON YOUR CAR. Walker Chambered Pipe is available as replacement for Chevrolet, Ford, Mercury and Oldsmobile. It's matched to the engine of each car for high performance, fuel economy, long life.



APPROVED AS ORIGINAL EQUIPMENT. Walker Chambered Pipe is now used as original equipment on a number of 1964 models. Only Walker Chambered Pipe has original equipment approval. You are assured of a perfect fit.



APPROVED SOUND, LOW BACK PRESSURE. Walker Chambered Pipe is tuned to original equipment sound levels. Specially designed for each car to give rich, powerful tones. Less restriction of exhaust gives you total engine performance.



AVAILABLE NOW. Ask your favorite service station or garage operator about Walker Chambered Pipe today. You'll find that this road-tested new exhaust system will cost you no more than an old-style muffler and pipe.

WALKER

WALKER MANUFACTURING COMPANY

• RACINE, WISCONSIN

Painting Your Fiberglas Boat

(Continued from page 138)

ing time. Epoxy paints just won't keep a wet edge without some assistance. If you're painting on a warm day, invest in a can of "retarding agent". Make sure you get *retarding* agent and not *reducing* agent. The latter is nothing more than thinner used for cleaning up afterward.

The retarding agent does just what its name implies: it slows the curing of the paint and keeps a workable wet edge which will allow you to do some brushing out. A friend of mine claims that retarding agent is a waste of money. He says you can get the same effect by simply using less catalyst than the mixing directions specify. Maybe so, but I prefer to go according to the paint maker's version of Hoyle. I'd advise you to do the same.

Achieving the desired color can sometimes be a problem. The standard epoxy paint colors are white, black, deep red, dark blue and dark green. If you want a light gray, a pink, a pale blue, or a duck-egg green, you've got to mix two base parts—white and the dark color involved—with the two small cans of catalyst.

These paints usually are packaged for convenience—a quart can *half full* of white or color base and a pint can *full* of catalytic agent. You simply pour the catalyst into the half-full base can and go to it. Keep stirring as you paint to prevent the colors from separating. The directions specify a waiting time between mixing and use, usually fifteen minutes. Follow this direction or the paint will be thin, watery and seemingly poorly pigmented.

Maintaining the paint at an even temperature is just as important as the temperature of the air, and this isn't as simple as it sounds. Part of the catalytic reaction which starts the curing involves a rise in mix temperature. As soon as the catalyst is added, the mix begins to heat. This reaction in epoxy resin is very pronounced—so much so that the pot in which it is mixed must be handled with care. The reaction in epoxy paint isn't so obvious, and perhaps you'll never notice it. Nonetheless, the paint is resin-based and the catalytic reaction will generate heat.

Some painters float their paint pots in pans of ice water. With a small boat, the time required to paint the hull is short, and the pot life of these paints (time they will remain uncured after mixing) is long enough to be able to dispense with the waterbath treatment, except in hot weather.

The term pot life brings up another point. Once you've mixed *all* the base with *all* the catalyst, *all* the paint starts to cure. If you don't use it all, you'll have to

throw away the excess. Should you want to knock off for awhile, cover your paint pot and put it in the refrigerator. The lower temperature will slow the reaction and curing markedly. It may even delay it overnight—but don't count on that.

If you know you're not going to use a whole quart at one painting session, mix only half the base with half the catalyst in a separate container. The rest has an almost indefinite shelf life and will keep until you need it again. One quart should be enough for two coats to the topsides of a 16-foot boat. The deck will probably be a different color entirely, though you'll handle the paint exactly the same.

Use masking tape where you change colors at water and deck lines, and remove the tape shortly after you've finished painting. Don't wait for the paint to bond the masking tape to the hull.

TWO COATS OR ONE? I'm from the old school that says if one coat of paint looks beautiful, two will protect even better and look twice as good. On the bottom you'll want at least two coats. I've put on as many as four in areas of localized wear and contact with the beach. The second coat of bottom paint can go on as soon as the first is dry, probably in about an hour.

On hull and decks, two coats will give you a better looking job and hold gloss, color and sheen longer. Most paint manufacturers say to wait at least six hours between coats of epoxy paint. If you apply the second coat within seventy-two hours, you don't need to resand. However, after seventy-two hours the first coat is completely cured, and the second won't bond without a rough-up.

DRESS FOR THE JOB. Wear your oldest old clothes when you're using vinyl or epoxy paints. They'll never be the same again. If your skin is sensitive, wear gloves. Above all, don't breathe the paint fumes overlong, and avoid smoking and open flame, as with any paint.

HOW GOOD A JOB? That's up to you, of course. I don't pretend to have all the answers and you'll probably work many variations on my themes before you find the right ones for you and your boat.

If you need any encouragement, here's what happened to me after I finished the job. On launching day last spring, a kind gentleman standing nearby asked me if my boat was new. Looking her over, I could honestly see why he asked. With glistening white topsides and sparkling gray decks she looked brand new, perhaps even better than new. She's my pride and joy, and I'm happy to say she looks it.

There's no reason why you can't make your fiberglas boat look like the apple of your eye and keep her that way. ★★



Daytona



Pomona



Phoenix



and you

In Daytona, Richard Petty drove a brilliant blue 1964 Plymouth Super-Stock to victory in the famous Daytona 500-mile race.

At Pomona, Tom Grove's "Melrose Missile" (a 1964 Plymouth Super-Stock) was Top Stock Eliminator in the NHRA Winter-nationals.

At Phoenix, Dave Strickler and his '64 Dodge Ramcharger won

top honors in the AHRA Drag-strip Championships.

And where do you come in? Perhaps as a spectator to America's latest million-fan sport, (82,240 people watched the gripping action at Daytona, over 50,000 lined the dragstrip at Pomona). To cheer the winning performance of these competition-equipped cars from Chrysler Corporation and to wit-

ness in person the excellence of Chrysler Corporation engineering.

Or, better still, be an active participant in another of America's favorite new pastimes—driving one of the 1964 cars from Chrysler Corporation. The cars that daily demonstrate this same engineering excellence, developed and proved in laboratory and on test-track, and confirmed by competition.

Plymouth • Dodge • Chrysler • Imperial



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SEE BOB HOPE AND THE CHRYSLER THEATRE, NBC-TV, FRIDAYS

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100% PURE PENNSYLVANIA

Tri-ex Refined three
extra steps for

**Maximum performance,
Maximum protection,
Maximum economy**

Scientifically fortified
to clean as you drive

It pays to be particular about
your oil—use WOLF'S HEAD.

**WOLF'S HEAD OIL REFINING CO.
OIL CITY, PA.**

Carburetor Adjustments

(Continued from page 162)

up and down in the carburetor throat and tighten the screw. Check choke adjustment by operating the cable several times. Usually, if the choke plate is properly positioned in the open position, it'll be okay in the closed position.

With automatic chokes, you adjust the housing cover (bottom photo, page 162). Though some manufacturers allow the cover to be positioned one or two marks rich or lean to compensate for seasonal operation, most mechanics leave the cover and housing marks in line, regardless of temperature.

Those additional adjustments required on some carburetors include:

1. **Fast Idle:** This adjustment is made to provide easy starting of a cold engine. It involves the correct interplay between the choke and throttle valves. When properly adjusted, the choke restricts the air flow while the engine is starting (to provide a rich mixture), and the throttle valve is kept open so the engine idles faster than normal when started. The adjustment is made only on carburetors with automatic chokes.

2. **Unloader:** This adjustment, too, is made only on those carburetors with automatic chokes. When adjusted properly, the unloader clears an over-rich fuel mixture from the carburetor by enabling the choke plate to open wide when the driver holds the accelerator pedal to the floor. This permits starting of a flooded engine.

3. **Anti-Percolator Device:** High under-the-hood temperature could cause fuel to boil in the carburetor. When this happens, vapor pressure builds up and pushes fuel into the intake manifold, flooding the engine. Some carburetors are equipped with an air bleed that permits this pressure to pass out of the carburetor before it causes harm.

4. **Dash Pots:** Most cars equipped with automatic transmissions have a dash pot to overcome the tendency of the engine to stall should the driver remove his foot too quickly from the accelerator pedal. It is connected to the throttle linkage and closes the throttle slowly to idle speed regardless of how quickly the pedal is released.

Now that everything's perking just right, it would be criminal to upset the balance of the carburetor with a dirty air cleaner—so get a new one. However, in putting the air cleaner cover on the carburetor, be careful not to over-tighten the wing-nut. This could collapse the air horn throat or impair the action of the choke plate. Tighten the wing-nut until it's just snug.

★ ★ ★

Anything four paints can do this one paint can do better

*Forget about different paints for siding and shingles, masonry, trim and galvanized metal. Just remember this one new kind of paint.
Dutch Boy Latex House Paint.*

By James Symon

Before you start painting this year, or next year, or any year, take a look at your house. Then take a break. And think. If your house has surfaces of masonry, shingles, concrete, wood siding, you'll not need up to four different kinds of paint to do a good job. You'll need just one. Dutch Boy Latex House Paint.

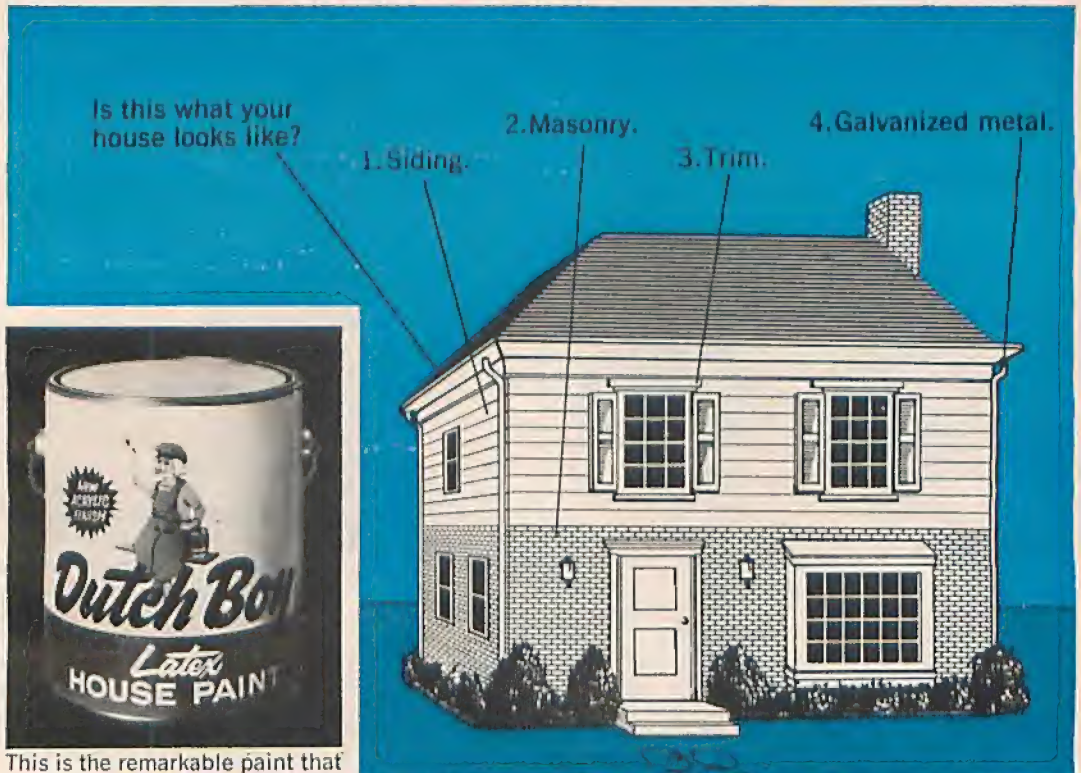
Want to know why a latex house paint works where conventional paints won't? Here's why. Dutch Boy Latex House Paint has a latex base. It does a perfect covering job on just about any surface you can name. But that's not all. It has lots of other advantages.

To start with, a latex house paint goes on more easily. It flows out to an even surface without leaving brushmarks. You can stop or start without it showing. (This is a real

time-saver when you are painting your house bit by bit.) Another point: Latex doesn't chalk away. And that means colors stay brighter longer. In fact, Dutch Boy Latex House Paint has been found to hold its color so well you can come back and touch up 3 or 4 years later and not see the difference.

How long does Dutch Boy Latex House Paint last? Well, frankly, nobody really knows. (Houses painted four or five years ago are still bright and weather-tight.) One thing is certain, however. This new paint is just about the most efficient house paint ever developed.

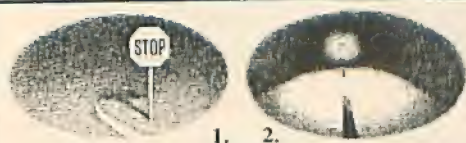
Where can you buy it? From any Dutch Boy dealer. See him. He'll give you any help and advice you need. He's in the Yellow Pages.



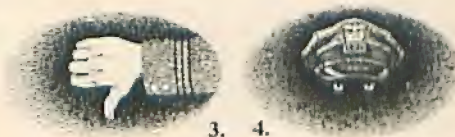
This is the remarkable paint that does so many jobs so well. If you haven't used it, try it. If you have, congratulations.

You can use up to 4 different paints on a house like this. But wouldn't you rather use just one? PRODUCT OF NATIONAL LEAD COMPANY

4 reasons why you'll benefit from this 30-second "Push-Pull" exercise



1. **SAVES NERVES.** When you drive at night, signs and pedestrians can loom up fast. With one headlamp, you are giving yourself only half a chance to see ahead. With tail lights out, you're vulnerable from behind.
2. **SAVES DECISIONS.** One-eyed cars call for one-man decisions. Quickly now: Which light is out? Or is it a motorcycle? Can you get by? Time's up! Now you know how the other guy feels when the one-eyed car is yours.



3. **SAVES TRIPS.** Burned-out lamps cause 60% of all rejects at vehicle safety checks. Take 30 seconds to check your lights or have 'em checked *before* inspection. Why make two trips to earn your safety sticker?
4. **SAVES MONEY.** A burned-out tail light, headlamp or turn indicator can signal a cruiser. When you break the law you invite a warning or even a ticket—to make it an expensive trip.

The exercise:



PUSH
THE BRAKE



PULL
THE SWITCH

CHECK YOUR LIGHTS TODAY

OR, if you shun exercise, have 'em checked where you normally have your car serviced. Got a burnout? Now exercise your *choice*. Ask for dependable G-E lamps, the brand most people prefer. General Electric Co., Miniature Lamp Department, M-50, Nela Park, Cleveland, Ohio 44112.

Progress Is Our Most Important Product

GENERAL ELECTRIC



Stoves for Campers

(Continued from page 127)

multiple-burner stoves have stamped metal tanks, two half shells joined by a seam all the way around, and although they don't compare with drawn brass, they are generally efficient and durable. Brass valves, fuel lines and fittings are desirable indications of good quality.

It is particularly important to have individual regulating valves for each burner, rather than a single one, and handles long enough so the controls can be reached with large pans on the stove. There should also be ample space between the burners to accommodate good-sized utensils.

The better large stoves are equipped with adjustable side wind screens. They may not seem important in the sporting goods store, but they're a great aid to cooking in even the slightest breeze. Make sure they can be set off to the side, leaving sufficient room for the larger pots.

Smooth, rounded corners on the case will save on injured hands and reduce wear and tear on other equipment. Sharp, box-like corners rubbing against a tent in the car trunk can cause expensive damage.

Good Legs Will Help

Better quality stoves will have "piano hinge" construction at the lid-case joint, spot welded joints and rolled exposed edges on the base. The grill should be sturdy, heavy metal. The finish on the stove should be good baked enamel; there should be a carrying handle, and for areas where you won't find camp tables, folding legs to keep the stove off the ground.

Newest addition to the growing list of camp stoves is the propane (Butane, LP gas, bottled gas) stove. Most popular have been the one and two-burner models that use small disposable cans. The can is simply pressed against a needle valve that punctures the top of the can, and the stove is ready to go. There are also disposable cylinders that attach to a screw valve, identical to those used on a propane blowtorch. This is an easy stove to operate, and it gives a clean, hot flame, but the cost is high. A cylinder of propane that will last about five hours costs about \$2.

For the car camper, where weight is not a major consideration, there is a large, refillable propane tank that will operate a stove for many hours without refilling. These units are detachable and can be filled at any fuel dealer. They are expensive and bulky but they will operate gas lanterns and stove at the same time.

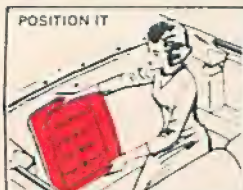
In the final analysis—quality considered—the type of campstove perfect for you is the one that fulfills your needs. ★★★

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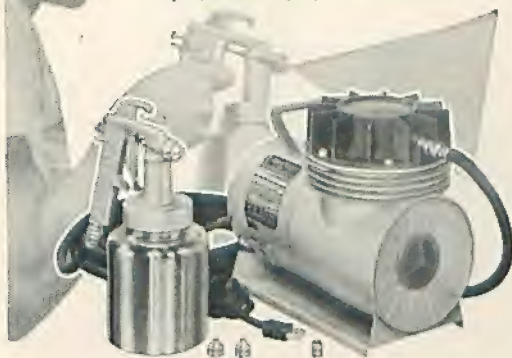
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Metal Benders for the Shop

(Continued from page 174)

ring without distortion. First clamp both parts upside down to a piece of flat steel, and tack weld at each side, where the handle joins the ring. When these welds cool, reclamp the unit as shown at B and run a full weld across the top, using a $\frac{1}{8}$ -in. E6011 electrode at 115 amps. The ring and weld area should be immediately swathed in rags (or covered with sand or ashes) to slow cooling. When the metal is at room temperature, unclamp and grind the weld bead flat with the handle surface. Then clamp the unit upside-down again and run a full weld across the joint, again insulating it for slow cooling.

The flat bender is a simple socket plate. In the layout on page 174, the spacing of the holes is given in o.c. dimensions that create between-pin spaces to take a variety of thicknesses. For easy passage between pins, increase each space a hairline when transferring the pattern centers to the block with a prick punch. Though the pin holes are only $\frac{3}{4}$ -in. deep, drill the $\frac{1}{8}$ -in. center holes *through* to prevent suction and ease removal of stuck pins.

You'll want a pair of $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$ and $\frac{3}{4}$ in. pins. For occasional use, pins made of hard steel rod (the bright-plated kind, available in 3-ft. lengths at hardware stores) are tough enough. But if you plan to use the jig fairly often, cut the pins from drill rod. If you'll use the jig a lot, harden them.

The photo, top left page 174, shows the use of the jig for putting a radius bend at the end of a strip of $\frac{3}{16}$ x $\frac{3}{4}$ -in. hot rolled steel to be used as a handrail. The bend is made a bit at a time by pulling on the work. You can bend $\frac{1}{4}$ -in.-thick strips the same way if the vise is strong enough to withstand the tension. If you're not certain, heat the metal red, first. This is a good idea, too, when making tight radius bends in thinner stock.

The second photo on 174 shows steps in bending a big S-hook around $\frac{3}{8}$ -in. pins. The material is $\frac{1}{4}$ -in. hard steel rod; the pins are spaced $\frac{1}{4}$ in. for the first bend, then moved as shown for the second. The excess stock is then trimmed off.

Bends with this jig may not always be as well shaped as you need—that is, they may not be snug to a given radius, due to the "spring" inherent in the metal, and to the fact that the material must provide its own leverage. And if a quantity of identical items must be made, you lose some time cutting off each one as it is formed. For production or precision work, therefore, you're better off cutting the stock to straight, finished lengths first, then forming these on a radial bender. ★★★



if YOU LIKE PLAYING WITH BLOCKS, TRY THIS. With Chevrolet's Turbo-Fire 409 V8* block you can build to great heights. Say, 340 hp. 400 hp. Or, with the ingredients shown here, 425 hp. All three use the same block. Looks like the Rock of Gibraltar with 409 cubic inches of tunneling punched in it.

For the 425-hp 409 we add all those lovingly machined, cast and forged items above. Twin 4-barrel carburetors. Impact-extruded pistons. Forged steel connecting rods and five-main-bearing crankshaft. Cast alloy iron camshaft. And two heads fitted with lightweight valves. Mechanical valve lifters. Along with things we didn't show—header-type exhaust manifolds, dual exhausts, special clutch and heavy-duty radiator and suspension, among others. For the tamer 340- and 400-hp 409's, we use tamer bits and pieces here and there.

You can tuck a 425-hp Turbo-Fire 409 V8 into any '64 Chevrolet Biscayne, Bel Air, Impala or Impala Super Sport. And choose low gear ratios of 2.56:1 or 2.20:1 with the 4-speed all-synchrom shift*. With the 2.20:1 gear ratio you can get 4.11:1 or 4.56:1 Positraction High Performance axle ratios*. Isn't playing with blocks fun?... Chevrolet Division of General Motors, Detroit, Michigan.

*Optional at extra cost



Are You Carrying Excess Fat?

(Continued from page 89)

ment is read on a gauge outside the tank.

Since the lungs can never be completely emptied of air, the remaining air—the residual lung volume—is measured after the man leaves the tank on what amounts to a closed-circuit breathing device. Briefly, it involves a small cylinder of air from which all nitrogen has been removed. The subject exhales, just as he did in the water tank, then breathes back and forth through flexible tubes connected to the cylinder. When the nitrogen that was in the air in his lungs is equalized between his lungs and the cylinder, a reading is made. From it technicians can determine the amount of residual lung volume. This figure is subtracted from his volume displacement in the tank, because the body displacement should exclude everything but the four major elements of the body.

Now they have the subject's weight on the scale and his volume in the tank, minus all irrelevant material. Dr. Allen's formula now furnishes two factors, one of which is multiplied by the scale weight and the other by the tank volume. One of the two final figures is subtracted from the other and the result, Dr. Allen says, gives the subject's fat weight. This figure is subtracted from the subject's total weight on the scale to give the lean weight.

How Many Weights Do You Weigh?

And that's it. They now have the lean weight, the fat weight and the total weight. If the fat weight is more than 20 percent of the total, the subject has some reducing to do. The beauty of the system is that the fat weight can be told right down to pounds, ounces and even grams, if you like, and it need never be done again. Once the lean body weight is known—and it rarely grows past 21 or 22—just add 15 to 20 percent onto that for the proper fat weight, and you will know your ideal weight for the rest of your life.

While the formula used to translate body densities into workable figures is understood only by experts, the principle should be as easy to understand as it was when Archimedes dipped that gold crown into water. It's only because the human body is so much more complicated than a crown that makes it seem more difficult.

To sum it up, if two men weigh the same, the overweight man will be bigger in size than the well-conditioned man because his fat weight takes up more space than the other man's lean weight. Conversely, if they are the same size, the overweight man will weigh less than the well-conditioned man because his flabby fat body is

lighter than the other man's lean body.

The Air Force's second experiment to determine the exact amount of fat and lean in a human body is infinitely more difficult to understand, but much easier to explain—if that's possible. It involves the subject drinking radioactive water and, after it has been assimilated in the body, blood samples are taken and the water extracted from it and measured on a special geiger-like counter. The proportion of radioactive material in the measured samples, when used in another simpler formula, will give the lean and fat weight.

The theory is simple enough. If you took 10 units of the radioactive water and poured it into 100 units of plain water, after it was assimilated, every 10 units of plain water should contain one unit of the radioactive water. So, if they take 10 units of radioactive water and pour it into an unknown quantity of water (like the water in the human body), wait for it to assimilate, then take a sample, the ratio of plain water to radioactive water would give the total amount of plain water. If it was 20 to 1, the total would be 200, and so on. In the human body, the total amount of water varies among individuals, but the percentage is almost constant—it's 73 percent of the lean weight. So when the total body of water is known, add 27 percent to get the total lean weight. Then subtract the lean weight from the total body weight (as measured on a normal scale) to get the body's fat weight.

The two systems under study at the Aerospace School do not always produce the same results for the same person, but they are so close at times that it suggests that one or the other might be used commercially some day for the average layman. The Air Force is skeptical, however.

The water tank method is cumbersome and the radioactive method, with its associated equipment for extracting water from blood, is too expensive for any large-scale use. Still the idea is intriguing. Football teams, for instance, at their first practice sessions, might go through the tank one by one to find out just how much overweight to take off before the season starts. And, to repeat, wouldn't the women of the world love to know just exactly how much excess fat they're carrying!

To confirm this latter theory, some of the girls in the school's offices were asked if they'd like to go into the tank. They mentioned two drawbacks.

Since the subject must enter the tank nude, a nurse would have to conduct the test. Also, she would have to be deaf, dumb and blind. Said one of the girls, "I'd love to know how much fat I have, but I don't want anyone else to know." ★★



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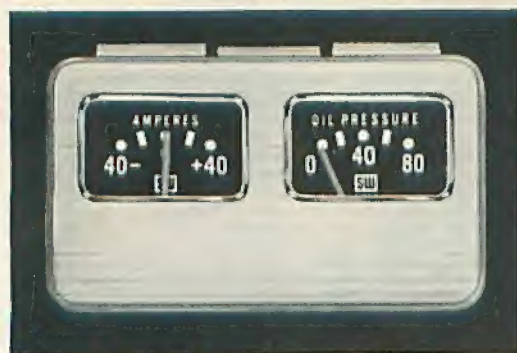
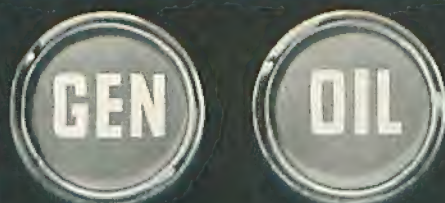
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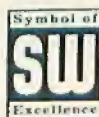
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Fireman, . . . Save My Game

(Continued from page 93)

for a homer in last year's World Series.

I decided to go with the fastball again. Here's why: the 0-1 count is not the place for a waste pitch. It is the place to put your strength on the line, even if it means pitching to the batter's strength. Other firemen have gone with their own "strong" pitch. Anyway, my control was on target and Tom now had two strikes.

The 0-2 count is normally the spot for a pitch just off the plate, a teaser. But, more guessing: Tresh had already gone eight innings, while I was fresh. Why not throw it by him, or at least try? I did—and he struck out.

Next One Is Maris

The next man up, with Kubek still dancing off third, was Roger Maris. Unlike many long-ball hitters, Maris can often meet an "off speed" pitch, or change of pace. His spectacular home-run record is built, in part, on the fact that pitchers don't always fool him, even with a deceptive motion. On the other hand, I felt doubly confident after getting three fastballs by Tresh with speed and control.

Since I didn't want Maris to get around on my hard one, I pitched him away. He took one fastball for a ball, then I caught the corner on three more fast ones and Maris struck out standing there.

With two away, I breathed a sigh of relief, but only a small one because the ever-dangerous Elston Howard was up. I have a healthy respect for Howard. He doesn't seem to have any weakness when it comes to speed. Give him a fast one and he'll hit it. Give him a breaking ball and he'll hit that, too. But—I started guessing—he's often tempted, especially in Yankee Stadium, to go to the opposite field. By now he knew I was leaning on my fastball almost exclusively. I figured he might go for the long ball to right on the first pitch, so I "jammed" him on the hands. He cut hard, and—lucky me—he popped up to end what might have been a disastrous inning.

Managers and pitchers agree that Elroy Face is right on the button when he says, "A starter may make a mistake and still have time for his club to come back and score for him. A relief man can't afford to make any bad pitches or it's the game."

Not having a schedule of appearances complicates relieving, too. When the headlines say RADATZ BLASTED FROM THE BOX, it's murder to be called out to try again the next day. A starter can take three or four days to recover, but the fire-

(Please turn to page 204)



New tool anchors wood or metal to concrete with 5 hammer taps

It's called Shure-Set.®

And it's so simple, it's a wonder no one thought of it sooner.

A fastener goes in one end of Shure-Set. You tap the other end with a hammer. A few light taps get the fastener started. Then tap-tap-tap-tap. It's done.

You've anchored a 2x4 into concrete. Or a furring strip. Or even light-gauge metal.

How does Shure-Set work? Inside the tool is a piston. It concentrates all the force of the hammer blow into the work. Makes fastenings, faster.

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out a lot of time or effort. But with every bit as much holding power as any other method of fastening.

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Ramser®
WINCHESTER-WESTERN DIVISION **Olin**

Fireman, . . . Save My Game

(Continued from page 202)

men are on call every day—and sometimes twice a day during doubleheaders.

No schedule also means limited time to warm up. On an ideal pitching day when the temperature is running between 75 and 80 degrees, a starting pitcher will warm up in 15 to 20 minutes. He gradually works into his "stuff."

When I shifted from starter to reliever, it was difficult at first, but with constant practice I learned the secret. It's this: the number of pitches I throw—not how hard I throw—determines the extent of my warm-up. Working with the catchers in the Red Sox bullpen, who cooperate by snapping the ball back as soon as it hits their glove, I now throw 25-30 pitches a minute out there, and can be ready to go in about 90 seconds.

Although I'm a fastball pitcher, you've probably noticed that most of the relief men around the majors have a bread-and-butter pitch in addition to a fastball, a curve and changeup.

Hoyt Wilhelm of the White Sox gives fits to the opposing batters and his own catcher with his knuckleball. The knuckler is an erratic pitch that lacks the spin

needed to keep it on course. It's unpredictable, and that's its strength.

Lindy McDaniel of the Cubs and Elroy Face of the Pirates, both well-respected relievers, attack their opponents with the deceptive forkball, a first cousin to the knuckler. When something went haywire with Lindy's fastball in 1961, he switched to the forkball as his "out" pitch and continued cutting down the batters while he puzzled over his hummer. Elroy Face used the same pitch in chalking up the all-time record for consecutive appearances as a relief pitcher. In September 1956 Elroy baffled Pittsburgh's opponents for nine Pirate games in a row!

Jack Balschun, Philadelphia's bullpen artist, throws a screwball. This is simply a curve that breaks in the opposite direction from a pitcher's normal curveball. Carl Hubbell made it famous, but you won't see it too often because the reverse twist puts a tremendous strain on the pitcher's arm. Yet Jack has it down to a science and the Phillies seem happy to let him keep on throwing it better than 75 percent of the time.

There's one other fellow you ought to meet. His name is—whoops! Almost gave it (or them) away. Anyway, he throws

(Please turn to page 206)

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SUBSIDIARY OF *Plough, Inc.*

Fireman... Save My Game

(Continued from page 204)

the spitball—but please don't quote me!

Relievers are handled differently by various managers. Fred Haney has often worked with a standing rule: Whenever the opposition has two men on base, a reliever should start warming up. In the 8th or 9th innings, his firemen should jump up when one opposing runner hits the base paths. Jim Brosnan, who has sweated for both Al Lopez and Freddy Hutchinson, insists there's a continent of difference in the way they handle their firemen. "Hutch (and others) uses man-to-man, percentage strategy and relieves after the trouble begins," Broz says, "usually to start a late inning."

Do relief pitchers really prefer their job? Every interview with a cub reporter turns up that question. The answer is a surprising "yes," but each fireman has a different reason.

More Kick Out of Saving One

Stu Miller enjoys the knowledge that his arm has the resiliency to take repeated beatings. For Elroy Face the challenge is the big factor. "I get a better feeling," Face says, "saving a game or holding the other club from scoring in a jam, than I did by winning a game I started." Hal Woodeschick, Houston's brilliant stopper, has come up with the wildest reason yet. He says his nerves wouldn't let him rest the night before a starting assignment. And now? Well... let's just say that Hal was cut out to be a reliever!

One final word: a relief pitcher must be his own boss. Before I put my foot on that pitcher's rubber I have to speak up. If my arm is tired from excessive pitching, or if I just don't feel up to the job, it's better for me to say "no" and not injure my team's chances.

But once he gets to the mound, he has to be a take-charge guy there, too. Let him stick out his chest and survey his domain. Satchel Paige, once the mainstay of the St. Louis Brown's bullpen, had the matter just right. "Ah's the boss out there," he used to say. "Ah know it, they know it, and we gets along fine." ★ ★ ★

Oldest Flowering Plants

Some of the world's oldest known vestiges of flowering plants were found several years ago in Colorado's San Juan Mountains. Eighteen-inch fossils imprinted on red rock show a palmlike growth that flourished 165 million years ago.

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The Gold Eagle Trailmaster is a full-sized tubular glass rod, in four sections. The finest fishing rod you'll ever own. A great pack rod for campers, back packers, traveling, or just plain fishing.

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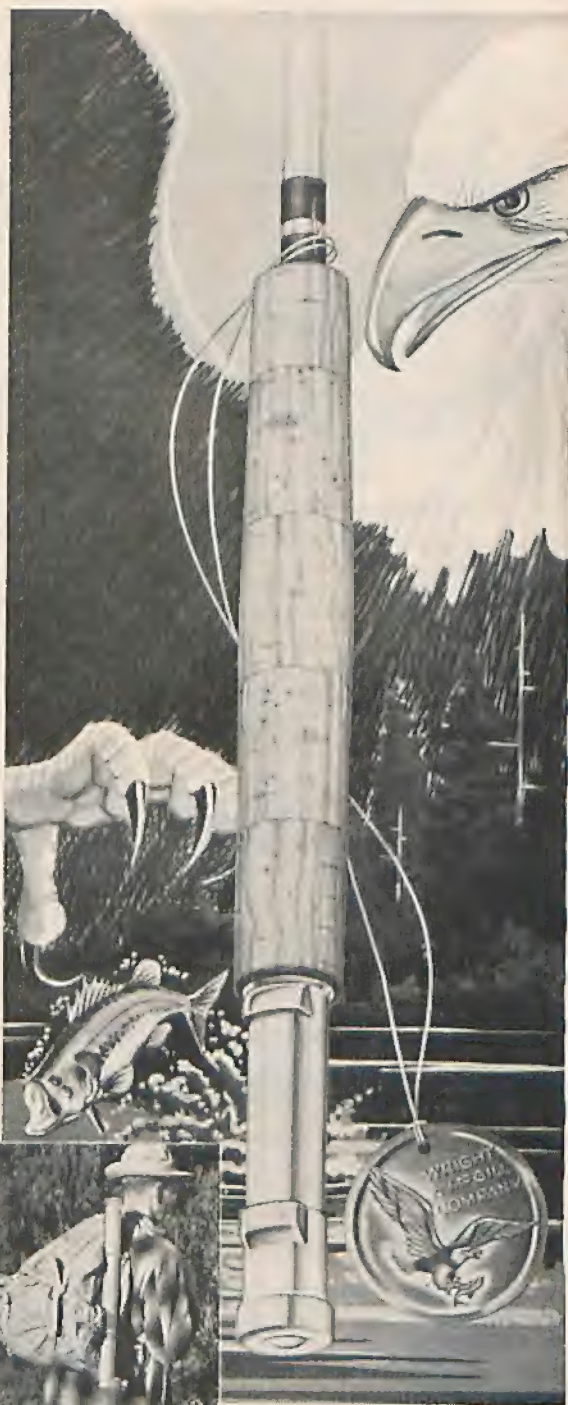
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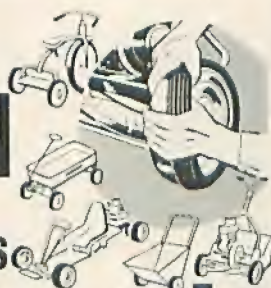
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Denver 17, Colorado

Our New Windmill Submarine

(Continued from page 97)

straight up through the water in a horizontal position. Reversing the process will move the vehicle straight down."

Haselton's submarine is kept on an even keel by automatically varying the pitch of the blades so that each one contributes equal torque. If this is changed so that unequal torque is produced by the two propellers, the vessel will roll to either side (or all the way over). As many variations in roll are possible as are variations in other types of movements.

While cruising forward, the motor up front is feathered, and the sub is powered by the rear propeller only.

Although the motor used to turn the propellers is electrical, it is unique in that it is an inside-out version of a conventional motor. The moving part, or armature, is the outer ring, to which the propeller blades are attached. This encircles the electric field. The motor also is unusual in that the propeller blades, blade motors and the armature are immersed in sea water. Consequently, the electricity to power the motors that turn the blades must be passed across the water. This is done with rotary transformers.

Aquabatic Breakthrough

On the aluminum model now being tested by the Office of Naval Research—as on the proposed 25-footer—the tandem propeller rings are turned by oil-filled DC motors, using a system of gears in the front and rear sections of the craft.

Many Navy officers feel that if the tandem-propeller method does everything it's expected to, it will be the biggest breakthrough in underseas technology since invention of the submarine itself. They envision a variety of uses for a full-sized tandem-propeller submarine.

It could, for example, not only dive to deeper depths than is now possible, but could maneuver easily at those depths—something conventional submarines cannot do now. This is because the propeller shafts of today's submarines rotate in large openings in the pressure hull, and these openings are becoming harder and harder to seal because of the higher pressures present, the deeper a sub goes.

In the tandem design, there is no rotating shaft piercing the sub's pressure hull. The propulsion machinery, including nuclear reactor, is inside the pressure hull. Nothing but easily-sealed electrical cables pierce the hull, carrying electricity from the turbo-generators to alternating current motors mounted in a unique ar-

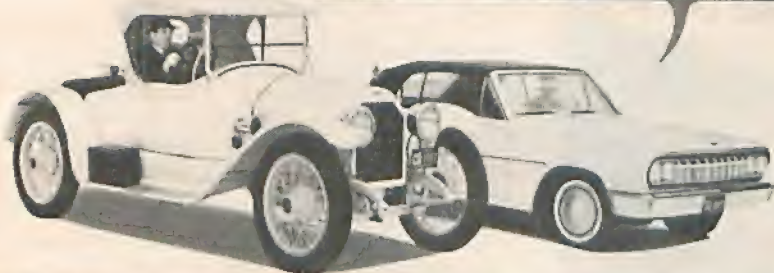
(Please turn to page 210)

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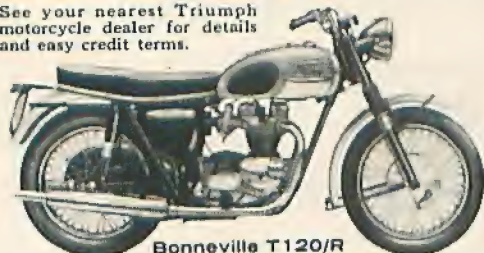
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Our New Windmill Submarine

(Continued from page 208)

range outside the pressure hull.

And since there are no propellers on the extreme stern of the proposed new submarine, it enables the stern to be used for launching torpedoes or missiles, or towing and retrieving objects in the sea. Today's late-model nuclear subs, which use a single propeller mounted on their sterns, either can't perform these tasks at all or can't use the stern in doing so.

A Polaris-firing sub with tandem propellers could have precise control of its movements during a firing at zero or low speeds. And a miniature tandem propeller vehicle containing underwater TV or a single observer could be launched from a Polaris firing tube to make underwater inspections of the mother vessel or of sea bottom missile depots.

The new sub's hull, furthermore, is not cluttered by outside controls such as rudder and stern planes. These projections, which add weight and mechanical complexity, are essential to the control of conventional subs at medium and high speeds, but are of little use at low speeds and of no use while the sub is motionless. On the tandem propeller craft, rudder and stern planes are not needed for either high or low speeds because control at any speed can be maintained simply by varying the pitch of the windmilling blades.

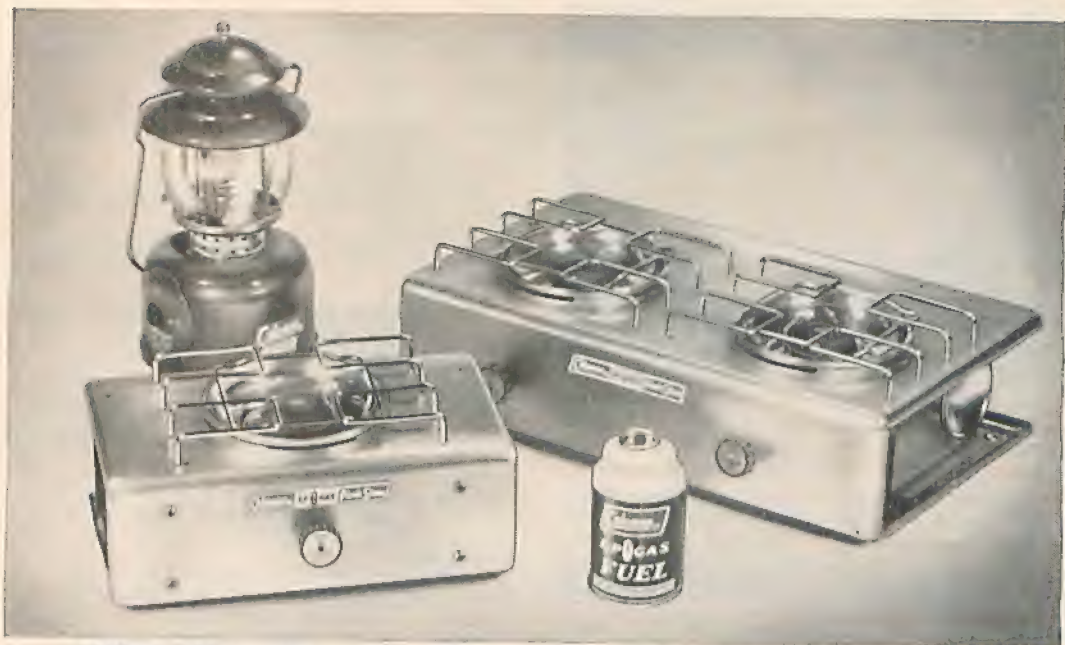
Silence in the Deep Six

Still another contribution of the tandem system is its quiet operation, something vital to many research activities and to all wartime missions. The propellers rotate at not more than 50 r.p.m.—which means that the blades carry light loads and create little or no noisy cavitation.

Since hull-encircling propellers are more subject to damage than conventional props, Commander Haselton envisions a fixed shroud over the blades, particularly the rear unit. Such a cover would increase the efficiency of the propeller by distributing the flow of water more evenly among the blades, and would prevent excessive flow of water around the blade tips. Like rudder and stern planes, the shroud on the rear unit would give additional stability to the ship at high speed.

It's easy to understand why the Navy is taking much more than a passing interest in the tandem-prop submarine. For years it has been looking for a system that will enable it to reach the ocean bottoms in large, highly maneuverable submarines.

Thanks to a clever officer with a goldfish bowl, the search may be over. ★★



NEWEST IDEA in outing gear from Coleman: Lightweight 1 and 2-burner picnic stoves and lanterns—all fueled with LP-Gas in throw-away cartridges.

NEW...LP-gas picnicking equipment

Brings instant outdoor light and cookery

Now, Coleman brings instant, carefree heat and light to outdoor fun—with new Picnic Stoves and Lanterns fueled by LP-Gas in disposable cartridges.

They're so light and compact you can stow an outfit in a corner of your car trunk—handy at the drop of a hint for a quick cup of coffee or a square meal, anytime...anyplace.

There's three full hours of cooking in every cartridge, too—genuine gas cooking, just like home. These polished aluminum stoves with chrome snap-off grills are perfect for picnics, boats, trailers, week-end and auto trips. We've found so many experienced campers like to take along *two* stoves—a full-size Coleman for big meals and more permanent camps—a smaller rig as an auxiliary unit and for quick cooking at the short stops.

The LP-Gas Lantern is a camper's dream—hours of crisp, white light from every cartridge—with all the rugged service of famous

Coleman gasoline Lanterns. All you have to do is strike a match and twist a valve!

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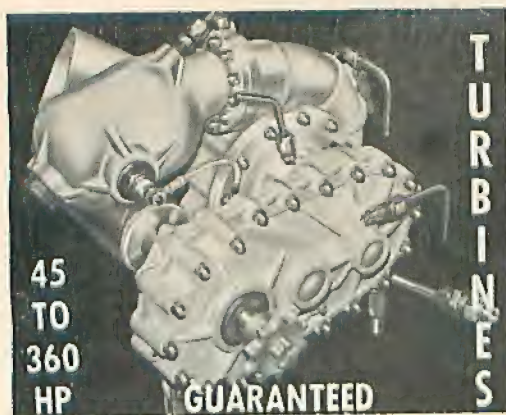
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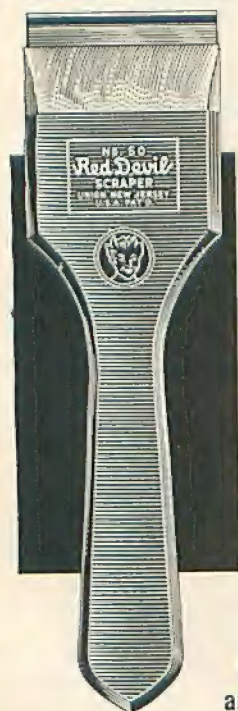
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Owners Report—Ford

(Continued from page 84)

"Like the quietness of operation."—Illinois craneman.

"I like the fact that I can run on oil 4000 to 6000 and get it greased every 30,000 miles."—Michigan salesman.

Let's not get too liberal on that oil change interval. Some experts still feel that 1000 to 2000 miles or a month should be the change interval in stop-and-go cold weather operation.

"Like its low maintenance cost and good power. It does not drink oil as my previous car did."—Texas agent.

"There's plenty of room inside."—North Carolina auto parts dealer.

True. The width, headroom and front-seat legroom are very good.

Once again we must accent the negative. Here are Ford owner complaints numbering six through ten.

"The doors do not fit properly. The window glass is cut too small so that the wind whistles."—Illinois electrician.

"Doors don't close properly even after adjustments."—West Virginia factory worker.

"The door on the passenger side has a wide opening between the door and frame even when closed."—New Jersey molder.

"The paint job is poor, especially on the sides; it shows orange peel in the paint surface."—New Hampshire laborer.

"I have had a rattle in the right hand door from the beginning and the dash lights keep going out."—Florida beautician.

"The body has not been as quiet as I would like it."—Missouri postman.

PM's testers are conscious of a certain amount of shake or "working" of the body on unevenly surfaced roads.

"I have had trouble with bad tubing in the transmission."—West Virginia electrician.

"Constant stalling even after it was adjusted."—Pennsylvania vice-president.

For final round of cheers, here are the owners' "best-liked" features ranked 11th through 16th on their questionnaire answers.

"I like its extensive vision."—Massachusetts clergyman.

"Like the way the roof goes out over the dash to cut down sun glare."—Illinois waterworks operator.

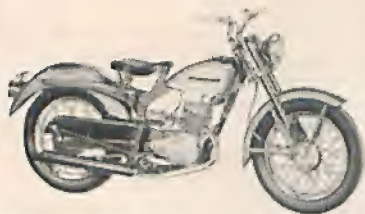
"The Ford I own is a convertible and the new glass rear window is very nice."—Ohio landscaper.

This could be the greatest boon to convertible owners since the advent of synthetic top fabric.

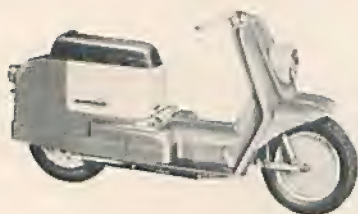
(Please turn to page 214)

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Swing Out On HARLEY-DAVIDSON!



Pacer Magneto-Generator. A Harley-Davidson design — produces consistent current, is trouble-free in all riding conditions even under water. Two separate circuits (two coils, two sets of breaker points) divide current-load needs equally, with capacity to spare.



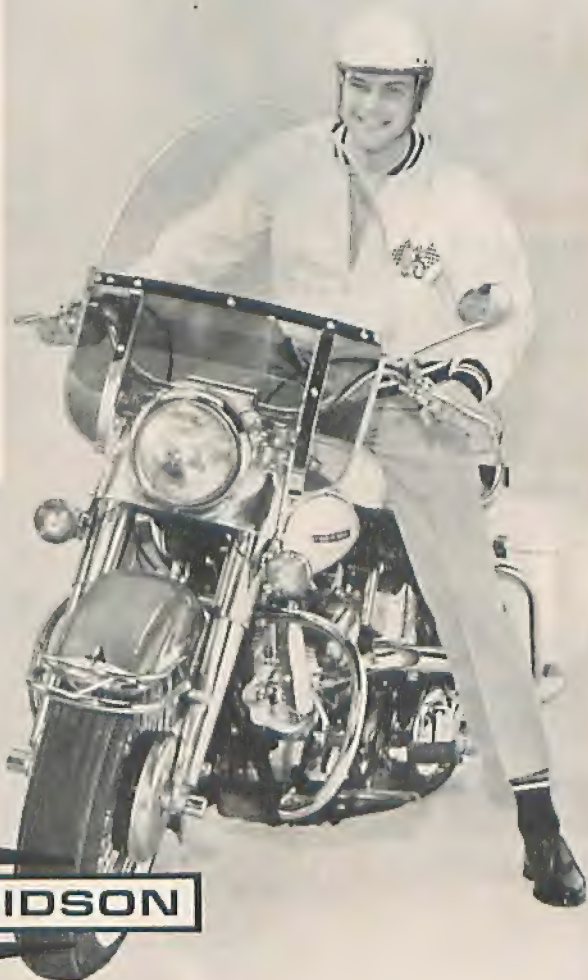
Topper Automatic Transmission. SCOOTAWAY® automatic transmission has you on your way at the twist of the throttle. No shifting, no jerking. Just quick, even acceleration from the spirited Topper H engine/drive team.



Duo-Glide OHV Engine. Duo-Glide features a 1200 c.c., 4-cycle, overhead valve V-type engine with flashing acceleration and brute strength. Hydraulic lifters operate quietly, never need adjusting. Nimonic valve material resists burning even at 1400°. Quality crankshaft assembly features pinion and sprocket shafts supported by anti-friction tapered roller bearings.

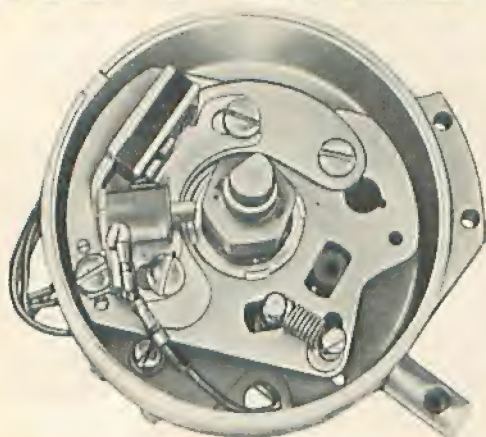
You'll find power to spare at your fingertips, pep aplenty in your ride when you test-ride a new Harley-Davidson. Sample any of these exciting performers — feel Duo-Glide's comfort and performance, enjoy Pacer's get-up-and-go, discover Topper's family fun and utility. Harley-Davidson has eight great models — one to meet every need. Test-ride your choice at your Harley-Davidson dealer.

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Owners Report—Ford

(Continued from page 212)

"Seats are high off the floor and firm and comfortable."—Ohio farmer.

"I like the washable interior, good looks, sturdy and comfortable seats."—Kansas lineman.

"It has smooth power steering, handles so easily in traffic and mountains."—Michigan factory worker.

"The 300 hp. gives me all the power I want and the overdrive gives me more gas mileage than I thought possible (15 m.p.g. over-all)."—Indiana mechanic.

All-but-forgotten overdrive is the secret of having your performance on tap while saving fuel. But it costs an extra \$100 and still requires shifting and clutch pushing.

"There are water leaks and air leaks from the doors and underneath the dashboard."—New York taxi driver.

"My specific complaint is that it downshifts on corners."—Minnesota psychiatric aid.

"The automatic shift is too sensitive in changing to a lower gear, if the acceleration is increased."—Texas insurance agent.

This can be adjusted and car should have been checked before it left 1) factory, 2) dealer.

"There's too much wind noise over the back doors."—Illinois physician.

"The car stands on end when the brakes are applied at high speed."—Oklahoma truck driver.

"The brakes are sometimes a bit uneven in stopping."—Iowa Air Force officer.

PM testers found this to be true when driving in wet weather.

"Too much road shock through the steering wheel."—Tennessee vice-president.

"It's a most difficult car to handle in the wind. I have to fight the wheel constantly."—Indiana auditor.

Ford's power steering doesn't give as precise a control as some other types under these circumstances.

That winds up the reports from owners from all over America, who have rolled up a total of 1,191,203 miles on their 1964 Fords. ★★★

Indoor Aurora

Indoor northern lights are being created at the Naval Research Laboratory to see how conditions leading to their formation affect radio signals. Around a model of the earth, NRL scientists beam electrons representing hydrogen particles from the sun to create an indoor miniature of the Arctic's beautiful aurora lights.

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So would we.

**But Savogran's Strypeeze semi-paste [for
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Midnight's Sky Divers

(Continued from page 79)

show late in 1961. He suffered a spinal injury, broken pelvis, fractured jaw and broken right hand.

As Sergeants Edge and Charette stand before a new class of HALO trainees, they share a common thought that sends shivers through them.

"A deep, gut-grinding fear occurs in our lives," Edge says, "whenever we are placed in absolute charge of students. We know only what is printed on their records. We try to look into each man's eyes, into his soul, to see if he is capable of pitting himself against death twice a day, 13 days in a row. We know through experience that once we do all we can - preaching, teaching, pounding, ranting, raving, anything to get the point across - there comes a moment of truth. You have to tell that man to step out of an airplane at 25,000 feet."

Students spend the first two weeks on the ground. The first task is to wean them away from the umbilical cord - the static line that in the past has automatically opened their parachutes. They must be taught that their lives are in their own hands. Soon they are studying the art of free-fall stabilization, the use of arms, legs, the body itself, in the performance of aerial maneuvers. They learn the theory and technique of tracking through the sky and gliding to known points on the ground - before they pull the ripcord. They are told the dangers of tumbling, spinning, red-outs and other problems encountered by specialists in free-fall techniques.

Next they learn about canopy control, depth perception, when to hold into the wind or to use the wind to increase drift. They learn to watch the life-saving altimeter for the critical 2000-foot level.

Oxygen-Starving Them

Finally the class is packed off to an Air Force base to experience the symptoms of hypoxia (oxygen starvation) in an altitude or low-pressure chamber.

When they come back to Ft. Bragg they're ready to start learning in HALO's real classroom - the sky. Before they've finished, they're leaping from altitudes of 25,000 feet - the highest that Army aircraft can go - with equipment strapped to their bodies, front and back.

A few don't make it and are washed out - back to the static lines. Injuries cramp the style of others. Those who finish the course are bonafide HALO birdmen.

"We've conducted more than 1000 free falls since September, 1962," Sergeant Edge

(Please turn to page 218)

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Midnight's Sky Divers

(Continued from page 216)

pointed out, "and no one has been seriously injured. Of the 100 or so men we've trained so far, five suffered broken legs through human error, not because of system failure."

The training program is only one phase of the HALO committee's work. High above Ft. Bragg's MacArthur Lake, the birdmen are diving out of planes with scuba tanks under their back parachutes. Once the para-scuba diver hits the drink he must immediately free himself from a tangle of parachute lines and switch to underwater gear. This marriage of parachute and underwater equipment is one way to covertly approach an enemy shoreline from the air and underwater.

Art of Exfiltration

Another phase is "Sky-Hook," or the exfiltration of a soldier marooned deep in enemy territory. If he's beyond the range of helicopters he can be rescued by donning specially-made coveralls, strapping himself into a harness, and sending aloft a cable attached to a balloon. An approaching airplane, flying at speeds in excess of 125 miles per hour, can hook the cable and scoop the soldier off the ground with no ill effects. An automatic winch is used to haul the dangling man into the plane.

Last, but equally exciting, are scheduled tests that involve exits from fast-moving jet aircraft at altitudes around 40,000 feet. This would put the parachutists at record heights. A windshield beneath the jet will momentarily protect HALO committeemen as they slip into the turbulent, buffeting slipstream. Once body speed has slowed to 150 miles per hour or less, the remainder of the experimental dives should be "routine."

Exotic Future

HALO, para-scuba, Sky-Hook and free-falling from jets are only the beginning for the small band of daring men who are addicted to the ever-widening challenges on the horizon of space.

"I feel that what we are doing now is a pitifully small example of the expanding capacity of man to come up with amazing new systems," says Sergeant Edge. "I believe that in the next 10 years ballistically fired capsules will be capable of delivering armed soldiers—the ultimate weapon—to any point on earth. I feel that it is within man's capability to fire a fully-armed squad of men around the earth, bring their capsule back on signal, and land them safely on any given half-acre of land. I think this will be possible." ★★ ★



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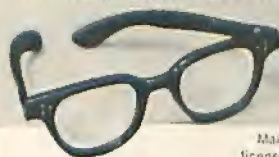
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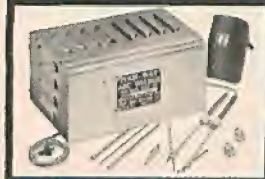
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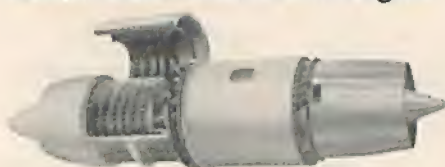
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Indianapolis 500

(Continued from page 74)

better than 155 m.p.h. for the four lap run.

What the average speed of the race may be depends on other factors, of course, such as the length of time speeds are held down under the caution flag. Conceivably, an all out, accident-free race could be won at a blistering average of as much as 155 m.p.h.

Some Interesting Entries

Master builder A. J. Watson, whose front engined roadsters have won 8 of the last 10 Memorial Day classics, is entering two new rear-engined cars for the Leader Card team. One will be powered by an overhead cam Ford V8, the other by an Offy. The Offy chassis will have a 60 gallon tank for its alcohol while the Ford will have a 50 gallon tank for gasoline. Weight of these cars is about 1300 pounds.

That spells a one stop race in the making for Leader Card cars. Which of the two Rodger Ward will drive remains unsettled as we go to press. The Leader Card team will also be working to qualify two conventional front-engined Offy roadsters.

Dan Gurney, who drove for Team Lotus (Colin Chapman) along with Jimmy Clark last year, will field two Ford-engined Lotus cars this year. They will be essentially the same design as last year with minor suspension changes and, of course, the new Ford four-cam engines.

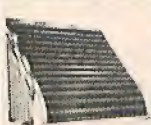
Ted Halibrand, famous builder of Indy magnesium wheels and other racing components is entering two new rear-engined cars this year. These cars will be of unit construction with stressed skins of aluminum uniting four circumferential magnesium castings forming the main "frame" members. These cars will be independently sprung with fuel carried in flexible bladders on each side holding a total of 50 gallons. Weight is expected to be between 1100 to 1150 dry.

One will be powered with a Ford four-cam, the other with an Offy. Old pro and high finisher (3rd 1962, 2nd 1961) Eddie Sachs is expected to drive the Ford. Some thought is being given to a nonstop race.

At this point, someone might ask: Why not run the Offy on gasoline, cut fuel consumption and shoot for a nonstop race? The answer is that the big four will drop from 400 to 350 horsepower when switched to gasoline and would also be subject to overheating and damaging detonation when coming out of the turns, especially if the air was hot. The Offenhauser's cooling system (water jackets around valves and radiator) just isn't ad-

(Please turn to page 224)

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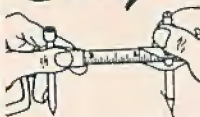


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Indianapolis 500

(Continued from page 222)

equate for cooling without the help of cooler-running alcohol fuel.

Irrepressible Mickey Thompson plans to make the scene with a team of three cars. Basically, they will be the low slung 1963 "vacuum cleaners" redesigned to accommodate the 15-inch wheels which most cars will use this year. However, Mickey will switch to Ford four-cam engines rather than fight the problems of designing an aluminum version of a Chevrolet V8 which would be as light as the Ford four-cam and produce the same power.

Indy would hardly be authentic without the appearance of the Novi V8s. These are smaller engines (with a displacement limit of 168 inches) because they are supercharged by high-speed centrifugal blowers. The old Novis developed 750 horsepower at racing speeds and qualified fast, when they made it, but also were plagued with mechanical problems as well as the handicap of 1700 pounds of weight. The 1964 Novis have, however, been dieted down to 1400 pounds by Vince Granetelli, and Vince has dropped the nose of two of his front-engined Novis to cut wind resistance. Studebaker Corporation's STP Division will sponsor two Novis.

A third car powered by Novi will have a Lotus-type chassis with four-wheel-drive designed by the Ferguson firm in England. The engine is up front and the drive is through a hydraulic torque converter to smooth the power flow between front and rear wheels. Driveshafts are offset to clear the engine on the way to the front axles and to clear the driver on the way aft.

Brabham-Zink Trackburner

Another interesting car now involved in qualification runs is the John Zink Trackburner built by English race car designer Jack Brabham, who drove the first European type lightweight with fully independent suspension at Indy in 1961. This car will be powered by an Offy, mounted in the rear, driving through a Colotti gearbox. Pedro Rodriguez has been mentioned as a possible driver.

At this writing, the qualifying lineup would seem to be about 20 of the new cars, that is, with either new chassis designs, new engines or both, and the rest of the field made up of rebuilt and refurbished Offy-engined roadsters.

And we'll wager there will be more new than old concept cars among the top ten finishers—in this year of the big switch at Indy. ★ ★ ★

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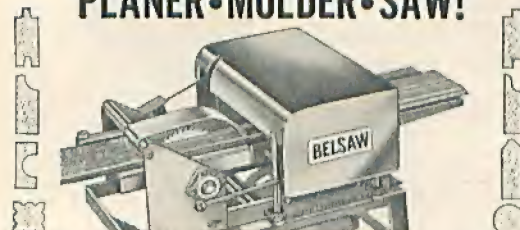
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